# CATALOGUE OF INSTRUMENTS AND MODELS

*in the possession of*

*The American Philosophical Society*

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*Robert P. Multhauf*

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# INSTRUMENTS and MODELS

*in the Possession of the*

*American Philosophical Society*

MEMOIRS OF THE
AMERICAN PHILOSOPHICAL SOCIETY
*Held at Philadelphia*
*For Promoting Useful Knowledge*

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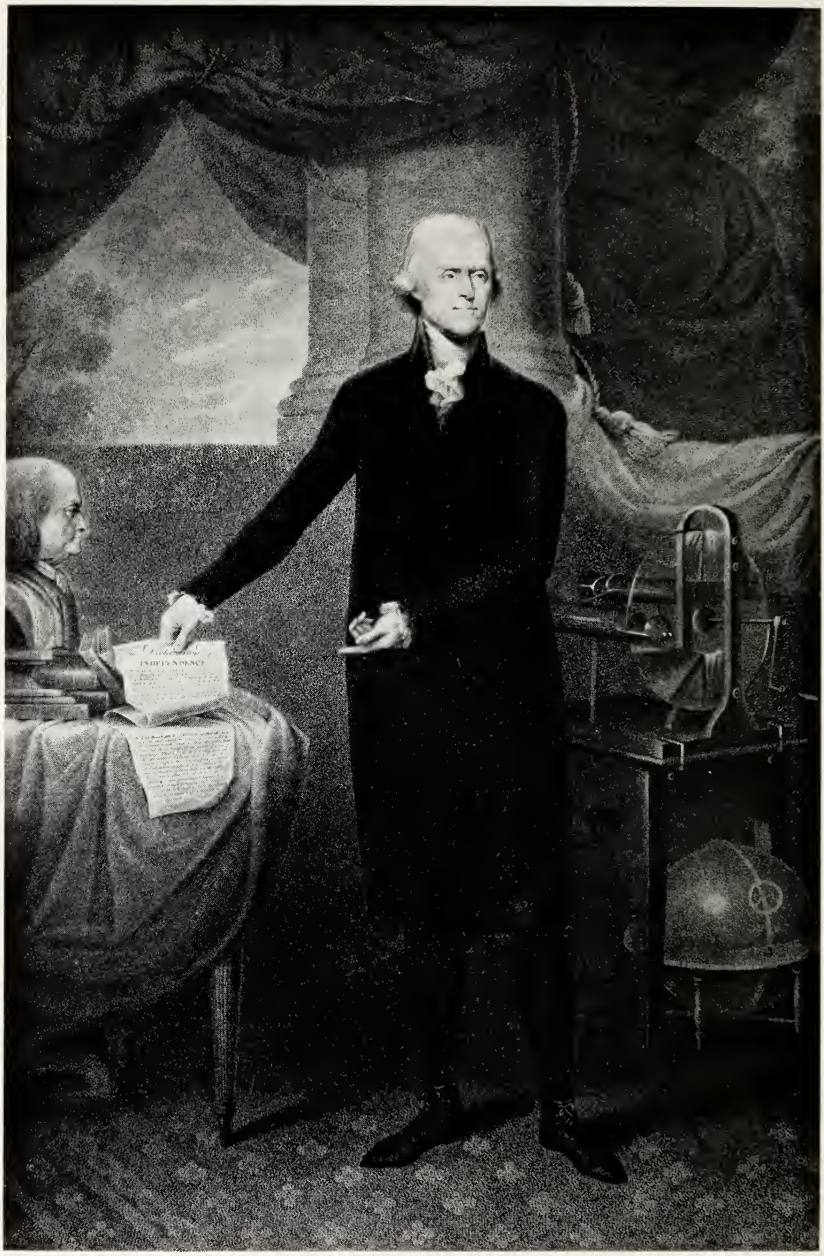

FIG. 1. Thomas Jefferson. An engraving by Cornelius Tiebout, thought to be taken from a lost portrait painted by Rembrandt Peale in 1800. The static electrical machine on the table and the globe beneath it are probably items 58-39 and 58-40 from the collection catalogued here. From the Library of Congress.

# *A Catalogue of*
# INSTRUMENTS and MODELS
## *in the Possession of the American Philosophical Society*

Compiled by
ROBERT P. MULTHAUF

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assisted by
DAVID DAVIES

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# *Preface*

Our ever-increasing distance from that period when science and technology underwent a spectacular development to assume their modern forms, and the selective character of the written record, tend to give that development a deceptive appearance of smooth continuity. Against this the occasional and more-or-less accidental survival of a few material objects from past science reminds us that it once enjoyed a real and not merely literary existence, and enables us to discover that much was going on which failed to leave a mark on "the literature." One can scarcely doubt that the history of science and technology would be better understood had more such survivals occurred.

The collection catalogued here, begun in the very childhood of American science, affords such a glimpse into its realities. The objects catalogued range from the crude work of badly educated mechanics to the elegant craftsmanship of some of the finest instrument-makers of the eighteenth century. Its value lies not only in its tangible documentation of early American science, but in the general picture it evokes of that era. The limitations of catalogues and cataloguers are such that it can only be hoped that the data given here will be suggestive of that picture.

Thanks are due to Dr. Derek Price, Dr. Edgar Wickberg, and to my colleagues at the Smithsonian Institution for assistance in areas of their specialties. I am especially indebted to Mr. L. C. Eichner for data generously furnished in connection with his restoration of the collection. They do not of course share the responsibility for errors. A word of appreciation is also owing to Mr. David Davies, for searching out evidence of these objects in the files of the Society, and to Mrs. Gertrude Hess and Miss J. A. Noonan for their unfailing response to my frequent requests for assistance in using the library and records of the Society.

Catalogue numbers are given at the end of the description of each item.

The specimens are numbered consecutively each year. Inasmuch as they were unnumbered prior to the preparation of this catalogue in 1958, all specimens on hand in that year are preceded by the number "58." Thus, a specimen marked 59-1 would be specimen number one from the year 1959.

All manuscript material referred to in the catalogue is in the possession of the American Philosophical Society unless otherwise noted.

Robert P. Multhauf
Smithsonian Institution

Washington, D.C.
March 16, 1961

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# *Early Museums of Instruments and Models*

Although the collection of objects relating to science was not unknown in antiquity, its appearance in the European Renaissance was more than a mere revival. It was a conspicuous manifestation of the spirit of that age, and not unrelated to the simultaneous rise of modern science. In natural history the formation of "cabinets" for instructional purposes, as well as for the edification and amazement of the public, was practiced at least as early as the sixteenth century. Today's great museums of natural history have descended from these cabinets. The custom of collecting scientific instruments is nearly as old, although the objective could scarcely have been the same as that of the natural history collector. In the latter field the permanent preservation of objects for their taxonomic value has an obvious justification. But the preservation of instruments has no such rationale, and remained an incidental event motivated by a variety of nebulous considerations long after the natural history museum had become an established institution.

The popularity of experimental physics and astronomy, as part of "natural philosophy," extended to the ranks of rich and noble persons in the sixteenth century; in fact the need for increasingly expensive apparatus made natural philosophy dependent upon their interest. From the point of view of the patron, the gratification attainable through support of this popular intellectual pastime was only one incentive to participation. For the instruments were often works of art. An aesthetic tradition already existed among the makers of the astrolabe and sundial, and the virtuosity expended upon their design influenced the maker of other instruments then in the process of introduction, such as the clock, microscope, and telescope. The power of this aesthetic convention is strikingly illustrated by the extension of its influence even to the early designers of steam engines in the eighteenth century. No one who has seen one of the still existing collections of decorative instruments from the sixteenth and seventeenth centuries will wonder at their appeal to the scientifically inclined princes of that time (see 58-66, figs. 23–25).

Possibly the earliest such collection to assume the aspect of a museum was that of the Landgraf Wilhelm IV of Hesse who

made Cassel a center of scientific activity in the latter half of the sixteenth century. If the interest of his successors was less in science it was not less in aesthetically pleasing apparatus, for which we have the testimony of this magnificent collection now exhibited in the Hessisches Landesmuseum, Cassel. A similar collection, now shown in Dresden, remains from the cabinet of Kurfurst August I of Saxony, who appears to have derived his enthusiasm from Cassel, and the residues of yet other sixteenth-century collections can be seen in virtually every European capital.

The transformation of these private collections into semi-public and finally into public museums is connected with the organization of scientific academies in the seventeenth century. The establishment of the epochal Florentine Academy of Experiment (Accademia del Cimento) in 1657 reflected the interest in science of the Medici princes, Grand Duke Ferdinand II, and his brother, Leopold. Toricelli, Viviani, and the other notable experimenters of this group manifested their interest in instruments in a decidedly practical way, and the short life of the society hardly left time for the consideration of a museum. But the instruments were subsequently stored by the Medici. They were first exhibited in 1775, and today form the nucleus of the Museo di Storia della Scienza in Florence. They illustrate both the continuation of the aesthetic tradition of instrument-making, and the intrusion of utilitarian simplicity which the requirements of the scientist were finally to force upon the instrument-maker.

At the time when the English Royal Society of London was founded (1660) there was no public museum of natural history in London. In 1668 the Society inaugurated a museum, principally to serve this function, with the purchase of a collection of "rareties." A positive effort was made to collect in this field, and met with sufficient success to require a rule that donations from non-members should be scrutinized by the President before acceptance. The arrangement of the museum ultimately became a considerable burden, and the collection was transferred to the British Museum in 1781, at the time the Royal Society removed from Crane Court to Somerset House. Although natural history appears to have been the principal concern of this museum, instruments and models were included. Indeed, the list in Grew's catalogue of the museum (1681)—air pumps, weather instruments, telescopes, microscopes, optical glasses, a ship model, etc. —is remarkably similar to the collection assembled a century later by the American Philosophical Society.

Machines and models of "improvements" also found their way

into the collections of the Royal Society and of the similar societies on the continent, especially that of the French Académie des Sciences, which appears to have had a considerable collection of models in the seventeenth century. Indeed, it was the impracticality of collecting machines, rather than a lack of interest in technology, that impeded the growth of museums of technology in this period, for the "useful arts" figure prominently in early statements of the objectives of these societies.

The eighteenth century was marked by an increasingly widespread movement to publicize and promote invention through privately endowed prizes and publicly endowed privileges (patents). In both cases the submission of models and their assembly into museums was conventional. One manifestation of the former movement was the establishment of societies for the promotion of the useful arts. The English society, the Royal Society of Arts, was established in 1754, having as its initial objective the stimulation of industry by means of prizes—and in the colonies the production of goods supplementary to those of the mother country. The acquisition of models was an immediate consequence, and a "Repository" was provided in the Society's building. An exhibition of models and machines was held there as early as 1761. It is of interest to note that the present collection of the American Philosophical Society contains one model which was originally submitted, in 1789, to the Royal Society of Arts (58-53).

# *The American Philosophical Society*[1]

Although the English colonists participated, as extensively as distance permitted, in the Royal Society of London, attempts were made as early as 1683 to establish a philosophical society in America. But nothing was accomplished through the first quarter of the eighteenth century save the organization of medical societies in the larger towns. The organization of the Library Company in Philadelphia (1731) provided something of the sort, and nearly from the first the Library Company had some of the aspects of a museum, as it undertook to collect not only specimens from natural history and ethnology, but even scientific instruments. It will be recalled that the glass rod for electrical experiments which was used by Franklin and the other early Philadelphia electricians was presented by Peter Collinson to the Library Company. On the whole, however, the Library Company seems to have stimulated rather than satisfied the demand for a philosophical society, and in 1743 a proposal for the establishment of an "American Philosophical Society," by Benjamin Franklin and John Bartram, led to the organization of a society whose effective existence lasted little beyond a year. Its prospectus was directed particularly to those fields which might be expected to generate museum collections, natural history and the promotion of the useful arts, but its imperfect organization and early decline were not conducive to any such consequence at this time.

The idea of a society particularly directed towards the promotion of the arts was also present in America in the mid-eighteenth century. The early books of the Royal Society of Arts contain copies of letters from the ubiquitous Franklin, suggesting the formation of a similar society in America, and he was a corresponding member of the English society in 1756. The practical establishment of this type of society on this continent seems, however, to have been brought about by the inconvenience occasioned to colonial commerce by the English acts restricting trade. In 1764 a society was founded in New York on the pattern of the

[1] See Edwin G. Conklin, A brief history of the American Philosophical Society, *Year Book Amer. Philos. Soc.* for 1946–1959, and Brooke Hindle, *The pursuit of science in revolutionary America, 1735–1789*, Chapel Hill, N. C., 1956. I am especially indebted to the latter.

Royal Society of Arts, which it imitated in offering premiums for improvements, if not in the collection of examples thereof. Two years later "The American Society for promoting and propagating useful knowledge" (hereafter referred to as the American Society) was established by a group of young Philadelphians who had previously been associated in a self-improvement club modeled after Franklin's Junto. From the outset this organization did maintain a cabinet of models of inventions, one of which (58-11, fig. 17) is now in the present collection of the American Philosophical Society.

The organization of the American Society very nearly coincided with the reorganization of the American Philosophical Society, in late 1767. Having been dormant for over two decades, the latter body found itself in competition for members with the American Society, a rivalry which was terminated by a merger of the two in December, 1768, under the name "American Philosophical Society, held at Philadelphia, for Promoting Useful Knowledge." To the bent of the American Society for the promotion of invention, the Philosophical Society added an enthusiasm for physical science, an objective somewhat at variance with the proposal of 1743, but not surprising in view of the eminence Franklin had meanwhile attained in that field, and the enthusiasm prevalent in 1768 for participation in the observation of the forthcoming transit of Venus.

The American Society had a "Cabinet" before the merger, and the Philosophical Society may well have had one. At any rate the office of Curator was immediately set up, with Adam Kuhn, John Morgan, and Lewis Nicola occupying the three curatorships in 1769. The receipt of objects was usually—unfortunately not invariably—recorded in the manuscript Minutes, and occasionally printed in the *Transactions*. Not all objects received were destined for the museum, as is clear from the notes on the receipt of meteorological instruments, which were usually assigned to members for use. As had been the case in the European academies and the Library Company, the Cabinet was originally a repository for objects of immediate use rather than for antiquities. It is clear that even the models of—frequently improbable—"improvements" (machines) and scientific novelties received from Europe were originally conceived to be useful. As the passage of time cast doubt on this conception, and converted once utilitarian devices into relics, the Cabinet tended to become a collection of memorabilia, although it continued to house apparatus for the scientific work of the Society until about 1840. For a half century thereafter it became an increasingly musty, if venerable,

collection of antiquities. Today it is easily recognizable as a unique collection of three-dimensional documents of the history of science and technology in this country.

There was no museum of natural history in America at this time, and, like the Royal Society of London, the Philosophical Society was at the outset deeply interested in the collection of objects relating to natural history. Early entries in the Curator's Donation Book include specimens of New Hampshire talc, petrified pine, woods of Jamaica, animal calculi, etc., and other evidences of a valiant but hopeless attempt to cope with this vast subject. When Lewis and Clark returned from their pioneer scientific expedition into the west the Philosophical Society became the repository of their collection of flora and fauna. In due course notable private collections came to the Society. In the nineteenth century these natural history collections were lent to the Academy of Natural Sciences of Philadelphia. Like the Royal Society, the American Philosophical Society recognized the limitation of its possibilities in the field of the natural history museum. This transfer left the nucleus of the present collection.

In terms of acquisition, the oldest extant specimen is a model of a ship's pump "driven without labor of men" (58-11, fig. 17). This appears to have been presented first to the American Society, although it is described in the first volume (1771) of the old series of the *Transactions* of the American Philosophical Society. It is the sole survivor of the museum of the American Society. It was followed over the next forty years by other models of inventions, such as a wind-driven carriage, sick-bed, pile driver, elevator, and lifeboat, not all of which still exist. The most interesting of these are a model of a mowing machine (58-1, fig. 16), and John Fitch's model of a boat to be driven by paddles on an endless chain (58-9, fig. 18). Other machines are relics of the Society's prize competitions. An elevator (58-19) and elliptograph (58-50, fig. 14) were submitted for the Magellanic Premium, a prize established in 1786, through the gift of 200 guineas by John Hyacinth de Magellan. Magellan was a Portuguese member of the Royal Society of London, who established the award for "the author of the best discovery, or most useful improvement, relating to Navigation or to Natural Philosophy, mere Natural History only excepted." A model of a locomotive boiler furnace (58-8) is almost certainly that submitted by John E. Wootten in 1878 for another prize offered by the Society for new methods of utilizing anthracite coal.

Among the scientific antiquities is one of the most remarkable examples of the artistry of the sixteenth-century instrument-

maker. This is the "Dial of Ahaz," (58-66, figs. 23–25) which may have descended from the seventeenth-century Rosicrucian community near Philadelphia. Among the early scientific instruments in the collection is a grandfather clock (58-62, figs. 20, 22) built by Edward Duffield for use in the transit observations of 1769. Two other instruments used on the occasion, a clock and astronomical transit of Rittenhouse, were acquired later. Astronomy predominates altogether among the early scientific instruments in the collection. In 1784 a Dolland achromatic telescope (58-25, fig. 3) "for the observatory of the Society" was the principal piece of several received from Samuel Vaughan, a recent English emigrant reputedly possessed of an unusually fine set of scientific apparatus. And the very end of the first period of the museum is marked by the acquisition, in 1838, of a "dialytical telescope" (58-26, fig. 5) after a long negotiation with the maker and his agent. This instrument, which was purchased and hence presumably intended for the Society's proposed observatory, represents a type of construction designed to obviate certain defects in the achromatic telescope.

Electricity is the only other scientific field represented by a significant number of notable specimens. Although they may include some of the oldest American-made scientific instruments in the collection, these are particularly inconspicuous in the records, and their identification is conjectural, although by no means improbable. If correctly identified, they include one of the oldest extant relics (58-38, fig. 9) of the Philadelphia electrical experiments instigated by Franklin.[2]

With the exception of the aforementioned locomotive boiler furnace, all items in the present collection which were received after 1838 should probably be described as scientific memorabilia. From this point of view, and in some cases from the point of view of the history of scientific instruments, they include some notable specimens, which would be highly valued by any museum. But the growth of the collection in the last century has been sporadic, and relates more to the history of the Society than to the history of science and technology.

[2] The only other extant electrical instrument which can with any probability be associated with Franklin's *early* work would appear to be a glass tube now in the Library Company, Philadelphia. Sufficient evidence is lacking for his early use of machines such as those extant in whole or in part in the Library Company, Franklin Institute and in the collection here catalogued (58-37).

# I

## *Apparatus for Astronomy, Geodesy, and Surveying*

No event or series of events marks more strikingly the advent of modern science than the invention of the telescope and the microscope. Both came into general use in the course of the seventeenth century, revealing hitherto unimagined wonders in the macro- and microcosmos, and stimulating the mind of the experimentalist in directions which were to lead to a new view of nature. The impetus given to scientific investigation by this extension of vision was far from spent when the American Philosophical Society assembled, and the exploitation of the possibilities of the telescope was one of the earliest concerns of the Society.

Its formation coincided with the approach of a long awaited scientific event, the transit of Venus of 1769. By the middle eighteenth century the gross discoveries made possible by simple observation through the telescope had been accomplished, and astronomers had advanced to more subtile questions. Kepler and Newton had shown the planets to be subject to mathematically definable laws, and the telescope had been adapted to the determination of the angular measurements upon which those laws depended. Transits of the inferior planets, such as Venus, across the face of the sun, provided a method of determining the value of solar parallax, from which its distance could be more precisely determined. It was generally recognized that the transit of 1769 would provide a rare opportunity to collect data on this problem, and European astronomers made an unprecedented effort to promote observations from sites around the world. Participation in this international project was the first important scientific enterprise of the Society, and observations were made by members from Philadelphia, Norriton (the home of David Rittenhouse), and Cape Henlopen, Delaware. The results were published in the first volume of the *Transactions*.

The collection includes three instruments used on this occasion, clocks made by Edward Duffield (58-62, figs. 20, 22) and David Rittenhouse (58-23, figs. 19, 21) for use at Philadelphia and

Norriton, respectively, and a transit telescope (58-24, fig. 2) made by Rittenhouse for use at Norriton. The latter may be the oldest extant telescope made on this continent.

Other telescopes in the collection recall the evolution of the instrument during this period, in the course of which the achromatic telescope was coming into use. The simple Galilean telescope gave a poor image, defective principally because of color dispersion due to unequal refraction within the lens (chromatic aberration). A remedy for this defect was found in the middle eighteenth century with the development of the compound lens of two glasses of counteracting refractive properties. Such lenses were free of color dispersion, and hence telescopes using them came to be called "achromatic." The firm of Dolland, London, was the leading maker. In 1784 the Society acquired a fine Dolland telescope (58-25, fig. 3) from Samuel Vaughan, probably part of the notable collection of scientific apparatus brought by him from England on his recent emigration.

The acquisition of telescopes was connected with the Society's interest in the establishment of an observatory, a recurrent objective into the nineteenth century. During that period the design of the telescope remained subject to considerable variation because the difficulty of producing flawless flint glass to some extent vitiated the advantages of the achromatic telescope. Among the variant instruments produced to obviate this difficulty was the "dialytical" telescope, an instrument having an auxiliary lens located within the tube for color correction. In the 1830's the Society purchased one of these instruments (58-26, fig. 5) from the leading maker, Ploessl of Vienna. Shortly after its purchase the idea of the establishment of an observatory by the Society came close to fruition. A subscription for its construction and outfitting had been authorized in 1835, and the City of Philadelphia had appropriated twenty-five hundred dollars for the purpose. Instruments were ordered in Europe, but it was discovered after the lapse of the usual period of several years required for delivery that some misunderstanding had prevented any action on the order. By this time (1841) the Philadelphia High School had brought the city its long-awaited observatory, and the project of the American Philosophical Society was abandoned.

The year 1840 saw the appearance of an observatory of another sort in Philadelphia, the undertaking of a great-grandson of Benjamin Franklin, Alexander Dallas Bache. This was the observatory established by Bache at Girard College for the study of terrestrial magnetism. The several aspects of the earth's peculiar

magnetic properties had been studied from the end of the sixteenth century, but the institution of regular and effective observation dates from the observatory set up at Goettingen in 1834. Other observatories followed rapidly, including that of Bache, which was the first in the United States. His observations, made between 1840 and 1845, were published nearly two decades later by the Smithsonian Institution and the Coast Survey, Bache then being head of the latter organization. At that time he had his magnetic observations converted into three dimensional models, one of which (58-29, fig. 6) was presented to the American Philosophical Society. The collection also contains an instrument for the determination of the horizontal intensity of geomagnetism (58-34, fig. 7), from an unrecorded source, but quite possibly part of the legacy of Bache.

**ASTRONOMICAL TRANSIT TELESCOPE** (Fig. 2)

Made by David Rittenhouse. Brass construction. Unmarked. 33½″ tube on 25″ axis. 1¾″ aperture. Focal length 32″. Mounted on a brass stand of two rigidly connected A-frames, for use on a table. Received in 1810.

This was described by William Barton (1817) as

> a transit telescope, fixed in the meridian on fine steel points: so that the hair in its focus could move in no other direction than along the meridian: in which are two marks, south and north, about 330 yards distant each: to which it could be readily adjusted in an horizontal position by one screw, as it could in a vertical position, by another.[3]

There are crossed hairs in the focal plane, semi-circular scale of 9″ radius attached to the bottom of the tube, and a suspended spirit level. Its construction is generally in accordance with earlier European convention. The attachment of the index to the frame through a toggle is an unusual feature which would not appear to enhance the accuracy of the instrument.

Rittenhouse built the telescope for his observations of the 1769 transit of Venus, and used it in his observatory at Norriton. In 1810 the executors of his estate requested that the Society reconvey the observatory and its site to them, at the same time offering to present to the Society the transit instruments (*sic*) and clock. A committee reported in favor of this arrangement on April 20, 1810, and proceeded to carry it out. The precise date of the receipt of the telescope and clock (for which see 58-23, figs. 19, 21) is not recorded. Rittenhouse also used at Norriton an equal-alti-

[3] William Barton, *Memoir of David Rittenhouse*, 171, Philadelphia, 1817.

tude telescope of his own construction. Although the wording of the proposal suggests that more than one instrument was involved, the latter, if it was ever received, is not now in the collection.

(58-24)

**ACHROMATIC TELESCOPE** (Fig. 3)

Marked, "Dolland, London." 43″ tube, fabricated of cast brass sheet. Focal length 45″. Total length of tube 46½″. Mounted on a mahogany tripod for use in a standing position. Received in 1784.

This is described in the Curator's Donation Book as

> . . . a 3½ foot telescope athromatic [*sic*] with brass tube, an eye glass for day objects, a 3 ditto for astronomy, on a mahogany stand, with rackwork to turn into the horizontal and polar positions, finder, sliding rods, with hook joints for steadying the telescope in use, made by Dolland.

The finder is a 9¾″ telescope with crossed hairs. The control handle for horizontal adjustment is missing, as is part of that for vertical adjustment.

The wooden tripod is interesting in that it can be used as altazimuth or parallactic mounting (the latter was a forerunner of the true equitorial mounting) so that the telescope might be used for terrestrial or celestial viewing. The wooden, cylindrical, telescope base on top of the tripod is divided into two halves of an angle of 25½° and pivoted at the center on a tapered axis, vertical to the plane of division. When the two halves form a cylinder, the top surface is horizontal and may be used for terrestrial viewing. By turning the top half 180°, the top surface makes an angle of 51° with the horizontal (the latitude of London). These two positions are indicated on the cylindrical bodies by two lines, 180° apart. The lines are marked by two thin ivory strips inlaid in the wood.

The firm of Dolland was founded by John Dolland (1706–1761), best known as the first successful commercial maker (from 1758) of achromatic telescopes. He was succeeded by his son, Peter, who brought the firm its universal reputation in the 1760's. Peter, who died about 1820, was elected to membership in the American Philosophical Society in 1772.

The donor, Samuel Vaughan (d. 1802), emigrated from England to the United States after the Revolution, and was elected to membership in the American Philosophical Society in 1784. He was responsible for the planning of the present Philosophical

Hall. Although reputedly possessed of a notable collection of scientific apparatus, he has been called "more a promoter of science than a scientist himself."[4] The telescope, a cabinet of optical instruments (58-56), and a Gunther's scale (now missing), were presumably part of the aformentioned collection.

(58-25)

**DIALYTICAL TELESCOPE** (Fig. 5)

Made by Ploessl, Vienna. Brass construction. 35″ tube; 2.95″ aperture. Focal length about 25″. There is an integral folding brass stand, for use on a table. Received in 1838.

This is inscribed:

Dialytical telescope for the use of the American Philosophical Society held at Philadelphia. Invented 1832 and made by S. Plösel in Vienna the 1 of August 1834.

There are two terrestrial and four astronomical eyepieces, all of the Huygens type, the use of which is described in an instruction sheet affixed to the box. The small intermediate lens characteristic of this type of telescope is located within the tube. It is a cemented doublet of 1.400″ aperture, now badly discolored.

The dialytical telescope is one of several types developed in an effort to improve on the early achromatic instrument. Glassmakers were unable to produce discs of flawless flint glass above 4 to 5 inches in diameter before Guinand's work at the very end of the eighteenth century, and Fraunhofer's from about 1812. During this period England lost her supremacy in the field, not least because of her maintenance of a high duty on glass. Her astronomers responded with further experimentation. Peter Barlow designed an instrument in which an ordinary crown glass objective was corrected by a small fluid lens situated further down the tube. In 1828 Rogers described to the English astronomical society a similar instrument in which the fluid lens was replaced by a compound crown-flint lens which shortened the focus for red rays and lengthened it for violet, without effecting the mean rays. This was the dialytical telescope, of which the continental optician, Ploessl, was oddly enough reputed the best maker. He sent a 6½″ instrument to Pulkowa to supplement Fraunhofer's Dorpat refractor, and made other large instruments for observatories at Naples, Athens, and elsewhere.[5] This instrument was acquired through the agency of John Vaughan, son of

[4] Hindle, *op. cit.*, 330.

[5] Ploessl and the dialytical telescope are discussed by H. C. King, *History of the telescope*, London, 1955.

the aforementioned Samuel, who initiated correspondence in 1832 with a member of the Hungarian Academy, Charles Nagy, of Pest, concerning possible sources for a telescope, or perhaps concerning Ploessl in particular. Vaughan ordered the telescope in 1833 and subsequently offered it to the Society for the cost of importation. This was accepted in 1835, at a cost not to exceed $200, the Society having meanwhile received, as a gift from Nagy, a hand telescope by Ploessl (58-27). The dialytical telescope, intended "for the observatory of the Society," does not appear to have been received until 1838.

(58-26)

**HAND TELESCOPE**

Marked "Plössl in Wien." Brass construction, outermost of four telescoping sections covered with reddened wood. 2″ aperture. Length 10¼″ closed, 32¼″ extended. Received in 1833.

This instrument was given the Society by Charles Nagy in the course of the negotiations for the dialytical telescope. The stylistic similarity to the earlier telescope of Blunt (58-28) is remarkable.

(58-27)

**HAND TELESCOPE**

Marked "Blunt, Cornhill, London." Brass construction, mahogany covered, one telescoping section. 1⅝″ aperture. Length 20″ closed, 35½″ extended.

The source of this instrument is unknown. Thomas Blunt was active as an apprentice to Edward Nairne, and later as his partner and successor in the important firm of Nairne and Blunt. This instrument probably belongs to the period after Nairne's death, in 1806.

(58-28)

**MODEL TO ILLUSTRATE THE DIURNAL VARIATION OF MAGNETIC DECLINATION** (Fig. 6)

Designed and presented by Alexander Dallas Bache. Plaster model of a three-dimensional surface, 11½″ × 10″ × 5″. Printed inscription:

Model of the magnetic surface presented in the discussion Part II of the magnetic observations made at the Girard College Philadelphia between 1840 and 1845. by Prof. A. D. Bache. Const. and modeled by Ferdinand Engel, Washington, D.C. 1862.

Handwritten inscription, "Presented by A. D. Bache." Received in 1862.

This model, referring to observations made at the Girard College observatory, 1840–1845, was made in 1862 at the Coast Survey. The observations are described in a 26-page pamphlet published as part of the Smithsonian Contributions to Knowledge, Vol. XIII, Pt. II, 1863. A note with the model refers to page 21 for the construction of the model, and to page 22 for its graphical representation. This note, dated Washington, D.C., September, 1862, states that it was Bache's intention to make two more models, of the horizontal and vertical forces. One of these is now in the Smithsonian Institution.

Bache was appointed Professor of Natural Philosophy and Chemistry at the University of Pennsylvania in 1828, and first President of Girard College in 1836. The opening of the college was long delayed, and in 1843 he succeeded Hassler as head of the Coast Survey, where he remained until his death in 1867. He was active in the Franklin Institute, President of the American Philosophical Society from 1855 to 1857, and first President of the National Academy of Science.

(58-29)

## INSTRUMENT FOR MEASURING THE HORIZONTAL INTENSITY OF THE EARTH'S MAGNETISM (Fig. 7)

Unmarked. Dial 6¼″ in diameter with cylindrical projection below. Mounted on three brass legs 6¾″ long.

The dial has 5⅜″ needle and scale from 0 to 110. The needle is mounted on a vertical spindle about 5″ long, the spindle being mounted on delicate bearings at top and bottom. A helical metal spring extends over 4″ of the spindle, and is attached to it at the bottom and to the frame at the top.

The source of this specimen is unrecorded. Bache is supposed to have begun his work in geomagnetism about 1830, and reported on his observations of the horizontal intensity in the *Transactions* (n.s. 5: 1 ff.) of the American Philosophical Society in 1837. The apparatus described there, "a needle, suspended by a fibre without torsion, and made to vibrate in a closed box," was certainly not the present instrument. Our instrument is illustrated in an article in the Society's *Proceedings* 84 (2): 253, 1941, on the development of geomagnetism where it is described as "an early type of relative intensity instrument," without further elaboration. It seems likely that it is to be associated with

Bache's early work, and may be one of the portable instruments used by him on his trip to Europe.

(58-34)

**SURVEYOR'S COMPASS**

Marked "Potts and Rittenhouse." 6″ compass set in 13¾″ sighting arm with sights 6¼″ high. On walnut tripod.

The construction of this instrument is conventional, and typical of others made in large numbers in the late eighteenth and early nineteenth centuries. This appears to be the only extant compass carrying the inscription "Potts and Rittenhouse."

David Rittenhouse is known to have omitted his given name on some of his instruments, whereas it is not known that Benjamin Rittenhouse did. Hence it is concluded that David is the maker referred to here. The name Potts was common— there were two among the early members of the American Philosophical Society. A Thomas Potts, one of the more obscure of this name, is said to have been a watchmaker, and to have been associated with David Rittenhouse.[6] It is concluded that he is the Potts represented on this instrument.

Presented by Mrs. Thomas S. Gates.

(58-32)

**THEODOLITE** (Fig. 4)

Marked "Tho. Heath Londini Fecit." 19″ telescope, mounted on 4″ vertical and horizontal circles. On tripod. Received in 1838.

This is an elegant example of the best workmanship of the mid-eighteenth century. The instrument was reportedly used by the Penn family, possibly John Penn (d. 1795), who was Heath's contemporary, and is known to have been interested in scientific instruments.

This is recorded as the gift of Dr. Philip Syng Physick (who died in 1837). Physick, an eminent surgeon, elected a member of the American Philosophical Society in 1802, was the son of Edmund Physick, who had charge of the Penn estates during the Revolution, at which time he may have acquired this instrument.

(58-30)

[6] Mrs. Thos. Potts James, *Memorial of Thos. Potts Jr.*, 241, Cambridge, 1874.

# II

## *Electrical Apparatus*

Electricity, as a field of experimental science, grew out of Gilbert's monumental treatise on the magnet (1600), and von Guericke's description of the (static) electrical machine (1672). Von Guericke's machine, a sulphur globe turned by a crank and electrified by turning against the hand, was the prototype of a variety of machines invented in the following century. By the middle eighteenth century many experimenters were occupied with electricity and a considerable literature existed. Because of the spectacular character of its manifestations, it had become a favorite subject with popular lecturers on science.

In 1743 or 1744 one of these lecturers, a Dr. Adam Spencer, seems to have been the source of Franklin's first contact with the subject. The most important piece of apparatus at this time was a glass tube which, when rubbed, constituted the "machine" for the production of the "electric fluid." Such tubes were apparently more common among "electricians" than the more expensive and cumbersome apparatus deriving from von Guericke's globe. A tube was presented to the Library Company by Peter Collinson in 1746, and was used by the Philadelphia experimenters in their early investigations. The demand of Philadelphians for electrical experiments was such that Franklin directed the manufacture of tubes in the local "glass house." One of the present specimens (58-38, fig. 9) may represent the product of this enterprise.

The Philadelphians were apparently not acquainted with machines of the type of von Guericke. Philip Syng, one of Franklin's fellow electricians, reinvented it, using a glass globe, and these too were made at the glass house. This may also be represented in the present collection (58-37). The plate machine, developed in Europe shortly after this time, is represented (58-39), as is the most important piece of accessory equipment, the Leyden jar. This device was invented or discovered in Europe in 1745–1746, providing not only the first convenient reservoir for the storage of static electricity, but a vehicle for much of Franklin's work. He contributed greatly to the elucidation of the Leyden

jar, but the battery in the collection (58-36, fig. 8), although it most certainly belonged to him, seems to derive from his later years rather than from the time of his celebrated experiments in electricity.

**BATTERY OF LEYDEN JARS** (Fig. 8)

Box 18″ × 13″ × 14″ high, unmarked except for a brass plaque (not original) stating that the battery was used by Benjamin Franklin. It contains thirty-five jars in seven rows of five, each jar having a height of 12¼″ and a 2″-square cross section. Each is covered with foil to a height of about 9″, and has a wooden cap from which contact wires project within. Through wires laid across the top, the jars are connected in series. Received in 1836.

This battery has been restored at some time in the past. Fifteen of the Leyden jars appear to be original; twenty are facsimiles and are so marked by a diamond point inscription on one side. The facsimiles were made in a mold which left a burr not present in the original, and are covered with foil on the outside only.

The donor, Joseph Hopkinson, accompanied the gift with a letter, dated April 1, 1836, stating that,

> my father was one of the executors of Dr. Franklin's will, and the legatee of his philosophical apparatus—a part of this flattering bequest was an electrical battery which the Dr. had used in making his celebrated experiments....

The donor's father, Francis Hopkinson, was listed in Franklin's will as legatee of his "philosophical instruments." His own father, Thomas, had been associated with Franklin in his earliest experiments.

The Leyden jar was discovered in 1745–1746. The introduction of the foil covering, as in the present specimen, was made by Bevis and Watson, and described in a paper read to the Royal Society on October 30, 1746. In general, Franklin seems to have had very expeditious notice of their work. He used the Leyden jar in 1747, and mentions a bottle "armed with lead" in a letter dated September 1. In 1748 he mentions an "electrical battery," made of sash glass armed with lead, as an innovation of the Philadelphia group.[7] His published work does not mention a battery which can be clearly identified with the present specimen.

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[7] The paper of Watson and Bevis was published in the *Phil. Trans. Royal Society of London* 44: 714, 1747. On Franklin's work with the jar and "battery," see I. B. Cohen, *Benjamin Franklin's experiments*, 183, 192, Cambridge, Mass., 1941.

In the absence of mention of such a battery as this by Franklin, and in consideration of its sophisticated design and elegant construction—rare, if it existed at all, before the 1760's—it is concluded that this battery is probably one of the numerous pieces of European apparatus acquired by Franklin in his later years. (58-36)

## GLOBE FROM AN ELECTRIC MACHINE

Glass globe with an iron axis and wooden end caps. There is an integral 3-sheave pulley on one cap. Unmarked except for an old, but not original, paper label associating it with David Rittenhouse. Diameter 9″. Length of axis 20″. Received in 1871.

It is stated in the *Proceedings* of the American Philosophical Society (12: 14, 1871–1872) that

> a letter was received from Wm. Lowber, M.D., . . . offering for the acceptance of the Society the glass cylinder [*sic;* this is probably a verbal error] of the electric machine belonging to his great grandfather, David Rittenhouse. . . .

In 1747 Franklin mentions the manufacture of electrical apparatus at "our glass house," including

> our spheres . . . fixed on iron axes, which pass through them. At one end of the axis there is a small handle, with which you turn the sphere like a common grindstone. This we find very commodious. . . .[8]

This was regarded by the Philadelphians as the invention of one of their group, Philip Syng, although globe electric machines had been known in Europe long before.

This is one of three relics of this type of machine extant in Philadelphia. There is in the Library Company the frame from such a machine, with the remains of a globe, the glass itself being missing. The length of the axis is 14½″. It will be recalled that the Library Company was the scene of some of the earliest experiments, but the provenience of this machine is not recorded. The Franklin Institute has a complete machine, again similar, but also differing in detail. Its globe is directly attached to wooden bearings, one of which has an integral two-sheave pulley, without the axial rod which characterizes the other two machines. Its diameter is 9¼″ and its axial length 13¾″. It was attributed to Benjamin Franklin by the donor, John Redman Coxe, who, when he presented it in 1826, left a letter tracing its descent from the great electrician.

It does not appear that any machines exist which correspond

[8] Cohen, *op. cit.*, 60, 177.

exactly to Franklin's description of those made in the Philadelphia glass house. The Society's globe is certainly the relic of a belt-driven machine such as those in the Library Company and the Franklin Institute. No evidence has been found that the glass house produced machines of this modified construction. The iron axis supports this possibility, however, as such machines, while not unknown in Europe, were not common. It does seem probable that Rittenhouse would have owned a machine from the Philadelphia glass house.

(58-37)

**GLASS TUBE FOR THE GENERATION OF STATIC ELECTRICITY** (Fig. 9)

Hand-blown, green glass tube, rounded and sealed at both ends. One end chipped. Unmarked. Diameter about 1″, 23″ long.

This is the type of tube used by Franklin in his earliest electrical experiments. He seems to have first witnessed an electrical demonstration in 1743 or 1744, performed by an itinerant lecturer named Adam Spencer. Although Franklin says that he subsequently purchased Spencer's equipment, his more specific account of the genesis of his own experimentation is connected with the receipt of a glass tube by the Library Company in 1746, the gift of Peter Collinson. Franklin goes on to say that he "caused a number of similar tubes to be blown at our glass house" to meet the demands of Philadelphians for electrical experiments. In describing these, he says, "our tubes are made here of green glass, 27″ or 30″ long, as big as can be grasped."[9]

The American Philosophical Society records make no reference to this specimen. It has been traditionally associated with Franklin and Rittenhouse, and may well be a product of the Philadelphia glass house, although this is not susceptible to proof. The Library Company possesses a tube which is reputed to be that presented by Collinson (green glass, diameter 1½″, length 26½″), and the Franklin Institute has a white glass tube with a stoppered hole at one end (diameter 2″, length, 28½″).

(58-38)

**ELECTRIC MACHINE**

Circular glass plate of 16″ diameter, on horizontal spindle turning between four leather-covered pads. It stands on a wooden platform. The collectors, conductors, and other attachments are missing. Unmarked, except as noted below.

[9] *Ibid.*, 49–53, 57 note 2, 58, 177.

Priestley, in his *History and Present State of Electricity* (2: 111, London, 1775) speaks of the disc or plate electrical machine as a recent invention, introduced independently by Ingenhousz of Vienna and Ramsden of London. The invention of this type of machine has been dated as early as the 1750's by others, but it is generally known as the Ramsden machine.

The Society's records contain no clear reference to this machine. In 1780 *Transactions* (o.s., 2: list of donations) mentions the receipt of "an elegant electrical machine" from M. Noel, M.D., of Paris (presumably not the telescope maker, Dom Noel). This could be the present specimen. Two of the leather pads are marked "Haut" and "Bas." It has been traditionally associated with Franklin, and this is possible as he is known to have procured electrical machines in Europe (see for example, B. Vaughan to Franklin, June 24, 1783).

(58-39)

# III

## *Geographical Apparatus and Models*

Like other fields of scientific investigation, geographical exploration was undertaken on an ever-increasing scale in the last half of the eighteenth century. When the American Philosophical Society was reestablished, Captain Cook had just embarked on the first of his epochal voyages which were to contribute so much to defining more precisely the face of the globe. This redefinition is called to our attention dramatically on a globe (58-40) "containing all the latest discoveries and communications from the most correct and authentic observations and surveys to the year 1799 by Cap$^{n}$ Cook and more recent navigators." The globe was presented to the Society by the London instrument-maker, Wm. Jones, in 1800, along with a companion celestial globe.

The geodesist was following closely on the heels of the geographer. In 1764 the Royal Society had resolved to employ Messrs. Mason and Dixon to measure precisely a degree of latitude in America, "in the neighborhood of Pennsylvania." In Europe itself geodetic work was sufficiently commonplace to allow a young man to contemplate making it a career. At the end of the century one of these brought to America his experience in Alpine geodesy, and left with the Society a souvenir of that work, a small plaster model of Mont Blanc (58-41, fig. 10). This visitor of 1805 was Ferdinand Hassler, who was to give an effective foundation to geodetic work in this country.

The interest of the Society in exploration was to be more directly shown in the beginning of the nineteenth century as it undertook to provide a home for specimens collected in the West by Lewis and Clark. These materials, dating 1804–1806, were subsequently lent to the Academy of Natural Sciences in Philadelphia, where they may still be found.

### PAIR OF TERRESTRIAL AND CELESTIAL GLOBES

18″ globes in wooden ring-stands 15¼″ high. Marked as described below. Received in 1800.

The terrestrial globe is inscribed:

To the Rt. Honorable Sir Joseph Banks, Bart., President of the Royal Society, this new British terrestrial globe containing all the latest discoveries and communications from the most correct and authentic observations and surveys to the year 1799 by Cap$^{n}$ Cook and more recent navigators. Engraved from an accurate drawing by Mr. Arrowsmith, Geographer, is respectfully dedicated by His most obedient h$^{bl}$ servent Wm. H. [partially obliterated] Bardin.

The celestial globe is inscribed:

To the Rev. Nevil Maskelyne, D.D., F.R.S., Astronomer Royal, this new British Celestial Globe. Containing the positions of nearly 6000 Stars, Clusters, Nebulae, Planetary Nebulae, etc. correctly computed and laid down for the year 1800 from the latest observations and discoveries by Dr. Maskelyne, Dr. Herschel, the Rev. Mr. Wollaston, etc. etc. is respectfully dedicated by his most obedient h$^{bl}$ servents [*sic*] Wm. G. M. [?] Bardin.

The celestial globe has, in addition to the usual constellations, others in the extreme southern hemisphere named for the air pump, mariner's compass, chemical furnace, sculptor's apparatus, microscope, painter's easel, clock, telescope, and drawing compass.

To both globes is affixed a paper tab, "Sold by W. & S. Jones, Holborn, London." In a letter of November 3, 1795 (Wm. Jones to J. Vaughan), Jones says, "I am chiefly engaged with others, in completing a new pair of 18″ globes more accurate than any hitherto constructed . . . I shall be pleased to present them with a [illegible word] when they are ready. . . ." In a letter of June 24, 1799, he states, "Enclosed you have a bill of loading for a pair of globes," and refers to another smaller package (which may have contained the compass, 58-33).

William Jones was apprenticed as an instrument-maker to his father in 1776, and was later in partnership with his brother, Samuel. The prominent firm of W. & S. Jones appears in directories from 1793 to 1822. William, who died about 1831, was elected to membership in the American Philosophical Society in 1800.

(58-40)

**MODEL OF MONT BLANC** (Fig. 10)

Plaster model 4″ × 6½″ × 2″ high, labeled, "Mont Blanc en relief." Painted green and gray and carrying numbers evidently related to a key which is now lost. Received in 1805.

This was presented by Ferdinand Hassler, who had just arrived from Switzerland. He was put into communication with

members of the American Philosophical Society who were then recommending a survey of the coast to President Jefferson, and he headed the Coast Survey when it was established in 1807. Hassler had left Switzerland because of troubled political conditions, but he found them nearly as troublesome here. In 1818 he was excluded by law from the headship of the Coast Survey! But he returned to its superintendency in 1832, at the age of sixty-two, and was able to give to it another decade of the geodetic competency it needed.

(58-41)

# IV

## *Meteorological Apparatus*

Meteorology was a popular scientific subject among the Greeks of antiquity, but with the adoption of Aristotelian cosmology as a dogma in the Christian era the superlunary region receded into changeless perfection, and all irregular phenomena were assigned to the region between the earth and moon. Such spectacular occurrences as comets and meteors tended to monopolize the interest of observers, and these were frequently thought more appropriately elucidated by theology than by science. The revival of scientific meteorology began in the seventeenth century.

The shock administered by the scientists of that century to the then venerable Aristotelian cosmology involved more than a rearrangement of the planets. When Galileo found unexpected imperfections in the heavens (1610), and Pascal found (1648) that certain atmospheric phenomena possessed a peculiar regularity, the traditional distinction between the two realms began to evaporate. The atmosphere and the region of the meteors came back into the province of science.

The revived science of meteorology was taken up eagerly by the members of the new academies of science. In the late seventeenth century they began the development of virtually the whole series of meteorological instruments in use today, the thermometer, barometer, hygrometer, wind direction and velocity indicators, and others. By the end of another century the instruments had become commonplace, and the attention of the scientist turned increasingly from the instrument to the systematization of its use, to the attempt—which still continues—to understand the weather.

Of a series of standard or newly-invented thermometers received by the Society in the eighteenth century nothing remains, for they were, in all probability, put to use by the members. We know this to be the fate of the hygrometers received from Nairne in 1788, and surmise that it was also the fate of the rain gauges and barometers received on other occasions. Of a considerable number of meteorological instruments received, the sole example to have survived in the museum is the decorative barome-

ter-hygrometer-thermometer received from Charles Goring in 1795.

## WHEEL BAROMETER

Marked "Bishop, Portland St." Mahogany banjo-shaped case for hanging on a wall, 40½" long, 12½" maximum width, containing barometer, thermometer, and hygrometer. Received in 1795.

The wheel barometer, a form of mercurial syphon barometer, was described by Hooke in *Micrographia* (1665). It transfers and magnifies the movement of the mercury through a float attached to a thread which passes over a pulley. An index hand is attached to the arbor of the pulley. Few were made before the middle of the eighteenth century, but it was the most popular form of barometer before the end of the century and was made well into the late nineteenth century.[10]

The sensing element of the hygrometer is missing. The hygrometers of such instruments were sometimes merely decorative fakes, but that of this instrument appears to have been an oat beard hygrometer, a type developed in the seventeenth century.

No information has been found concerning the instrument-maker, Bishop, nor concerning the donor, beyond the fact that he was Charles Goring of London, and presented the instrument through Samuel Vaughan.

(58-61)

[10] On the history of this type of instrument, see G. H. and E. F. Bell, *Old English barometers*, Winchester, 1952.

# V

## *Apparatus for Physical Science and Medicine*

The end of the eighteenth century was a period of prolific invention in the field of scientific instruments, and it may be supposed that the novelties brought back from Europe by philosophically inclined travelers were eagerly awaited. It seems probable that the hydrometer of Nicholson was received shortly after its introduction, perhaps from Nicholson's friend, Magellan, whose bequest to the Society in 1786 led to the establishment of a prize carrying his name. In 1803 Thomas Jefferson presented two novelties received from the continent, both of considerable interest. From Holland came an example of a device for sounding the sea (bathometer), newly invented and not to be patented for another year. From France came the apparatus of Guyton de Morveau for chlorine disinfection, a device which represented a landmark in antisepsis.

**POCKET COMPASS**

Mahogany block with inset compass and cover, 4″ × 4″ × ¾″. Contemporary (?) inked inscription, "Belonging to the globes presented by W. & S. Jones, 18 April 1800."

The inscription is the only evidence for the origin of this compass, which is not mentioned in the Curator's Donation Book, and seems a rather surprising accession to the globes. It may be referred to in an illegible passage in Jones' letter of November 3, 1795. On this see item 58-40.

(58-33)

**LENS**

Made and donated by Mr. William Parker, London. 6½″ double-convex lens in wooden frame. Unmarked. Received in 1784.

The identification of this specimen is conjectural. In 1784, along with his own donation of optical instruments, Samuel Vaughan presented two lenses 6½″ and 11½″ in diameter, in behalf of "Mr. Parker." Mention is made of a "stand with rackwork,

pillar, pinnion and apparatus so as to be acted upon by the focal rays in the most powerful manner." The instrument would therefore appear to have been an elaborate double burning glass of the type used by Priestley, Lavoisier, and others at this time. The present specimen is tentatively identified as the sole remaining part of this apparatus, on the basis of its dimensions and general appearance.

William Parker of London was elected to membership in the American Philosophical Society in 1785. He made glassware for Priestley and was reputed the best flint glassmaker in England. Vaughan had just come from England when he made the gift.[11]

(58-46)

## NORTH GERMAN MINT WEIGHTS

The weights are contained in a leather-covered box 4″ × 6″ × 2½″, to which is affixed a contemporary (?) paper label marked, "German weights for coins." Received in 1817.

The box contains nine (originally ten) brass weights marked, IMC 65536; 8L 32768; 4L 16384; Z6 (2L ?) 8192; 1L 4096; 2048; 1024; 512; 128. A slide covers a collection of ten (originally twelve) smaller silver weights, the largest of which is marked 128. The forceps is missing.

It has not been possible to fix the Sovereignty under which this particular system of weights was used. The Mark of Cologne was the common standard for gold and silver weights in many German states and in Denmark into the nineteenth century. The abbreviation IMC is believed to signify "one Mark of Cologne." In common usage the Mark was ½ Pfund, and in some cases (e.g. Denmark) the latter was subdivided into 65536 gran. In this case the Mark itself appears to have been subdivided in this way. The abbreviation L signifies the Loth, 1/16 Mark.[12]

Presented by John Vaughan.

(58-47)

## MODEL OF A BATHOMETER

Made by J. H. Onderdewyngaart. Brass instrument, 18″ long, assembled, with 3″ diameter float. In box labeled, "J. H. Onderdewyngaart, Canzius a Delft. la Fabrique des instruments de physique et de mathematique a Delft." Received in 1803.

[11] Priestley's letter of March 17, 1795, praising Parker, is in the archives of the Historical Society of Pennsylvania. See also E. Robinson, in *Annals of Science* 13: 5, 1957.

[12] J. H. Alexander, *Universal dictionary of weights and measures*, Baltimore, 1850. I am indebted to Dr. Bruno Kisch for advice in the identification of this specimen.

This instrument was invented by A. van Stiprian Luiscius, a physician and chemist of Delft, and described by him in his *Beschrijving van een zeepeiler of bathometer* ('s Gravenhage, 1805). J. H. Onderdewyngaart, a prominent instrument-manufacturer of that city from 1797 to 1810, undertook its manufacture, and received a patent on it in 1805.

The Library of the Society contains the French edition of Luiscius' book describing the device. It actually consists of two instruments, a fore-sound (*avant-sonde*), consisting of a float and weight which are separated upon contact with the sea bottom, and a bathometer, consisting of a similar device, but including an odometer as an attachment to the float. The externally visible parts of the instrument are the sighting staff and flag, the float, odometer, weight, and trigger. When used as a fore-sound, the odometer is eliminated, the weight being attached directly to a second float, identical to the first except for the bottom opening, which is modified to receive the weight. The trigger rod extends through the weight and terminates in a pike which is caught by two spring hooks within the weight. When used with the odometer, the trigger, upon touching the bottom, thrusts a peg into the path of the odometer vanes, thus stopping their movement. The odometer consists of four vanes geared to a dial and moved by its descent through the water. The full-sized instrument is described as having a float diameter of 8″ and a weight of 11 pounds.

This instrument is a mechanically refined version of the sounding devices described to the Royal Society of London by Robert Hooke on several occasions beginning in 1662. Hooke's first instrument was in principle like Luiscius' fore-sound, consisting of a wooden float and lead ball fastened together by a spring-hook which released the float when the device touched bottom. The depth was determined by timing with a pendulum, which required that the relative weights of the float and weight be such as to equalize the sinking and rising times. This delicate matter is given as one of the defects of the device by Hooke in his account of his improved instrument. The latter incorporated two odometers in the float, one actuated during the sinking and the other during the rising. In each case a trap-door cut off the odometer in its reverse travel. Another defect of Hooke's first device was the difficulty of locating it, and he remedied this, as did Luiscius, by a staff with a marker on the top.

Presented by Thomas Jefferson.

(58-51)

## WOLLASTON'S GONIOMETER

Marked "Pixii, Neveu et Succ$^{eur}$ de Dumotiez a Paris." Brass construction. 6″ diameter, on 4½″ diameter base.

This type of instrument for measuring crystal face angles was introduced by William Wollaston in 1809, and was made in this form for several decades. The present instrument was made in France by the successor, after about 1815, to the well-known firm of the brothers Dumotiez. N. C. Pixii, the father of the better-known inventor of the magnetoelectric machine, sent many instruments to this country.

This specimen is not mentioned in the records, but an old label affixed to it gives a clue to its history. This label reads: "The property of Dr. Hare . . . Smithsonian." Robert Hare, Professor of Chemistry at the University of Pennsylvania from 1818 to 1847, was possessed of the most remarkable collection of apparatus of his time. Upon his retirement, he presented this apparatus to the Smithsonian Institution, of which he was a Regent. It was almost totally destroyed in the fire which ravaged the Smithsonian in 1865. It would appear that this piece escaped the fire, perhaps through its having been placed previously in the American Philosophical Society collection by Joseph Henry, Secretary of the Smithsonian, and a prominent member of the Society. Or its present discoloration may mark it as a piece which survived the fire. In any case, it is one of a few pieces of Hare's apparatus which has survived. Regrettably, like the others, it represents not one of Hare's own inventions, but a piece of standard commercial apparatus.

(58-52)

## INSTRUMENT FOR MEASURING WIND PRESSURE ON A STRUCTURE

Made and presented by Professor Francis E. Nipher. A black walnut box 6½″ × 6½″ × 3½″ containing two measuring tubes; one with 1¼″ diameter screen disc × 5″ long tube and one with 6″ screen disc × 2¾″ long tube.

This is an experimental instrument fabricated of discs of bronze or brass screen, so attached to a brass tubing as to constitute an anemometer.

The device was designed by Nipher to provide a "method of measuring pressure on a structure," and described in the *Transactions* of the St. Louis Academy of Science in 1898.[13] His aim

[13] 8: 1–24, 1898.

was to obtain information concerning the distribution of wind pressure over buildings and other structures, to avoid compressions and rarefactions due to the collector itself, and atomizer action due to the movement of the wind across a tube. Two 2½" metal discs, with knife edges, contain, as a sandwich, a layer of porous material (brass screen) which extends about ½" beyond the discs. A tube communicating, through one of the discs, with the center of the screen leads to a distant pressure gauge. When the apparatus is held edgewise in the stream the projecting wire-cloth prevents compression on the windward edge and rarefaction on the leeward edge from affecting the pressure at the mouth of the tube. The complexity of the screen prevents atomizer action. An inclined water barometer was used as a pressure gauge. In the summer of 1897 Nipher conducted experiments on board an Illinois Central Railroad train which led him to conclude that the device does eliminate the complex air current effects which affect other instruments.

Francis E. Nipher (1847–1926) was a prominent physicist at the State University of Iowa and at Washington University in St. Louis, where he was noted for his work in pioneering the teaching of electrical engineering and for research in terrestrial magnetism. The present specimen, consisting only of the "pressure collector" itself, boxed for the occasion of the presentation, was given to the American Philosophical Society on the occasion of the Franklin Bicentenary (1906).

(58-55)

## CABINET OF OPTICAL INSTRUMENTS

Compound microscope, 14½" high; solar microscope with 6½" barrel; shagreen box containing accessories. Unmarked. Received in 1784.

The Curator's Donation Book refers to this as a "magazine microscope in a Shagreen case, consisting of a single, double, and solar microscopes." At present the Shagreen case contains a number of accessories, but will not fit the compound (double) or the solar microscopes. The lens of the single (simple) microscope is missing. The style of the instruments, nevertheless, suggests that they are part of a unit belonging to the period of this donation.

The fundamental forms of both instruments are those introduced by Cuff in England in the 1740's. Their assembly into a "cabinet"—that is, the fabrication of the three types as a unit—was an innovation of Benjamin Martin in the 1750's. A very similar cabinet is illustrated by R. S. Clay and T. H. Court.[14] This

[14] *History of the microscope*, 191, London, 1932.

cabinet, which, like the present specimen, is unsigned, is attributed to George Adams (d. 1773) or (less probably) to Martin (d. 1782).

The Cuff compound microscope was characterized by a rectangular pillar, screw adjustment of the stage, cross-shaped stage, compound body, and brass construction, all features of the present instrument. Martin, originally a scientific demonstrator for the lecturer, Desaguliers, became a professional instrument-maker by 1738, and exercised considerable influence on the development of the microscope. He introduced the second objective lens and the hinged pillar. He is said to have first placed the hinge at the bottom of the pillar, as in the present instrument, in 1776. Adams was an instrument-maker by 1735, and achieved distinction in the third quarter of the century as instrument-maker to King George III. He introduced the folding foot which, like the above-mentioned innovations of Martin, is found in the present instrument.

The solar microscope in this cabinet retains the basic form given it by Cuff.

Samuel Vaughan presented this with other instruments in 1784.

(58-56)

## NICHOLSON'S HYDROMETER

Brass construction. 7½″ long; float diameter 3″. Unmarked, except for the weights which are marked: 424, 384, 192, 96, 48, 24, 12.

This instrument was first described by William Nicholson (1753–1815) in a letter of June 1, 1784.[15] Although the principle of the hydrometer was involved in Archimedes' famous assay of a crown, Robert Boyle initiated its history as a scientific instrument with his description of a "New Essay Instrument" in 1675. Boyle's instrument was intended for the "proof of metals," that is, the detection of counterfeit coins. Others redesigned it with slight modifications, including Desaguliers, about 1730, who recommended it as an instrument for the determination of the densities of liquids. In the evaluation of spirituous liquors this has been its principal use. Nicholson's instrument was intended for the general purpose of the determination of the specific gravities of bodies, and he claimed greater precision, especially in relation to the effect of temperature. His instrument achieved its principal popularity among those addicted to "hydrostatical experiments."

[15] Printed in the *Mem. Lit. and Philos. Soc. of Manchester* **2**: 370 ff., 1785.

Nicholson was a prolific writer on science, an inventor and experimenter, best known for his early work on the Galvanic pile. He was a friend of Magellan, known to the American Philosophical Society as the donor of the Magellanic Premium; in fact the letter describing the hydrometer was addressed to Magellan. Magellan sent the Society a description of the Nicholson hydrometer in 1785. Although not recorded, it seems possible that the present specimen was received from him at the same time.

(58-58)

**APPARATUS FOR DISINFECTION** (Fig. 12)

Glass jar, 5″ diameter, 4½″ high, in walnut frame resembling book press. Frame height, 13¾″. The two specimens are identical, although the jar is missing from one of them. There is a fragment of a printed paper label, on which the words "de Morveau," and "l'air" can still be seen. Received in 1803 and 1805.

L. B. Guyton de Morveau, a prominent French chemist associated with Lavoisier in the reformation of the nomenclature of that science, is credited with originating the general method of disinfection of sickrooms which was in use through much of the nineteenth century. He was led to this through a problem which arose in 1773 in his native city of Dijon, where the opening of a crypt filled the cathedral with fetid odors and threatened to necessitate the closing of the cathedral. Conceiving ammonia to be the carrier of the "miasma," Guyton selected muriatic acid gas (hydrochloric acid) as a cure. He published an account of it at book length, and arranged for the commercial production of the apparatus by the firms of Dumotiez and Boullay. The method prescribed in this book, however, uses as the disinfectant oxygenated muriatic acid gas (chlorine), which had been discovered by Scheele about 1776 and subsequently used in disinfection by Cruickshank.

These two identical specimens are his "permanent" (as distinguished from portable) apparatus. It is a kind of press, in wood, in the proportions convenient to a ten- to twelve-bed sickroom. Forty grams of black manganese oxide are placed in the jar, and 1/10 litre of 39° Baumé nitric acid and an equal amount of 17° muriatic acid are added. The vessel is closed and reopened "when one judges proper." It is again closed when those nearest to it are affected, and thereafter its action depends upon the expansion of the gas liberated. The effect will be such that an opening period of 4–5 minutes in a ten-bed room will be detected by someone coming in an hour later through the most distant door,[16]

[16] L. B. Guyton de Morveau, *Traité des moyens de désinfecter l'air*, Paris, 1805.

an interesting example of the scientific statistics of the late eighteenth century!

Thomas Jefferson presented one of these in 1803, and L. A. Pichon, who appears to have been a French military officer, presented the other in 1805. There is no clue to the association of either of the specimens with a particular donor. Pichon also presented a letter which may have described the device, but it is no longer extant. Jefferson owned Guyton's book describing it, his copy now being in the Library of Congress.

(58-59; 58-60)

## LARYNGOSCOPE

Square mirror ¾″ side, on 7″ handle. Unmarked. Received in 1891.

The laryngoscope was developed and popularized in Europe by Türck and Czermak in 1857–1858. Although it was first described in print in the United States in 1860, Dr. E. Krackowizer of New York had already made use of it in 1858.[17] The present instrument was used by Mrs. Emma Seiler, who came to this country from Germany shortly before 1868. It is a commercial instrument, probably made in Germany.

Mrs. Seiler had assisted Helmholtz in his research on the human voice, and wrote and taught in this field after reaching the United States. She was a member of the American Philosophical Society.[18] Her interest in the laryngoscope would have been a normal one for a student of the human voice; in fact, the invention of the instrument had been at least foreshadowed by a voice teacher, Manuel Garcia, in a paper reported to the Royal Society of London in 1855. The extent of Mrs. Seiler's interest in laryngoscopy is suggested by the fact that her son, Carl Seiler, became one of the leading exponents in this country of the use of the instrument in medicine.

The instrument was presented by Joseph Rosengarten, in behalf of some friends and pupils of Mrs. Seiler.

(58-57)

[17] E. P. Boas, in *Jour. Hist. of Medicine and Allied Sciences* **5**: 452–454, 1950.

[18] An extended obituary of Mrs. Seiler appeared in the *Proc. Amer. Philos. Soc.* **29**: 151 ff., 1891.

# VI

## *Mathematical Instruments and Models*

### GEOMETRICALLY DIVIDED WOODEN CUBE

1½″ cube, inscribed with the letters *a* and *b* in various powers.

This is a cube illustrating the application of geometry to algebra. If it were required to cube the binomial *a* plus *b*, a cube may be found whose side is equal to $a^3$ plus $b^3$ plus $3a^2b$ plus $3ab^2$. Rectangles and cubes illustrating the derivation of algebraic equations from geometric construction were in common use in the nineteenth century.

The source of this specimen is unknown.

(58-49)

### ELLIPTOGRAPH (Fig. 14)

The instrument consists of a plate supported by an *L*-shaped arm and foot. A thumbscrew on the plate causes a pencil below to describe the figure, through a train of four gears, the last of which carries the pencil at the end of an arm. Closed up its dimensions are 4″ × 2¾″ × 2½″. Unmarked. Brass construction. Received in 1819.

This was submitted by an anonymous contender for the Magellanic Premium, whose letter is dated November 25, 1819. This letter mentions two instruments, both of which are sketched and described. One uses four gears (the present specimen), the other (apparently lost) two gears and a pair of cranks. The writer speaks of the employment of a constructor, and indicates that the workmanship is defective (as indeed it appears to be). He acknowledges that the elliptograph is common, but says that this is the first of the type, to his knowledge, "except one described in the New Edinburgh Encyclopedia." He continues with a mechanical and mathematical analysis of the instruments.

The elliptograph was a common instrument at this time. In a communication to the Royal Society in 1780 a Mr. Ludlam stated that "the instrument for drawing ovals upon paper or board is so common that a particular description of it is need-

less."[19] Its description as an instrument for drawing ovals seems to have derived from the fact that its early use, and perhaps development, is to be credited to craftsmen in the building trades. Elliptographs were principally of two types, geared, as in the present specimen, or based on the trammel, a grooved cross and a beam carrying two pins which slide in those grooves, the beam bearing a pencil. The latter device seems to have been more common at this time.

(58-50)

## INSTRUMENT FOR MEASURING THE HEIGHT OF PROJECTIONS ABOVE A SURFACE

Brass triangular base 10½" wide, supporting a vertical stand and pivoted triangular frame. Unmarked.

The base is mounted on three leveling screws, and has two spirit levels mounted upon its surface. The triangular frame is attached to it by a pivot which allows its long arm to extend beyond the base. That arm has an adjustable contact screw at its extreme end. The arm at right angles to this is acted upon by a cam which is fixed to the base. Movement of the cam causes a hand to move over a scale from 0 to 220, and the contact screw to rise vertically one inch per 100 divisions.

The identification of this instrument is conjectural. It appears not to be mentioned in the records of the Society.

(58-35)

[19] *Phil. Trans.* **70:** 378, 1780.

# VII

## *Mechanical Models*

The popularity which natural philosophy came to enjoy in the eighteenth century was probably due, above all else, to the triumphs of the "mechanic arts," that is, to the obvious utility of such inventions as the mechanical clock and steam engine. Physics was the core of natural philosophy, and physics was especially valued because of its useful applications. J. T. Desaguliers' *Course of Experimental Philosophy* (1734), one of the most popular texts, devoted as much space to the description of useful machines as to the principles of physics. The objective of the inventor was perhaps most frequently the improvement of agriculture or navigation, but his invention was most frequently mechanical in nature, as for example in the case of such items in the present collection as the mowing machine of John Jones (58-1, fig. 16) and John Fitch's paddle-boat (58-9, fig. 18). If we may judge from the surviving specimens related to the Magellanic Premium (58-19 and 58-50, fig. 14), the "improvements" submitted for that prize were chiefly mechanical in nature.

The specimens in the present collection have been classified, where appropriate, under the field to which they were applied—agriculture, timekeeping, graphic arts, etc. Under the present heading we classify mechanical devices which do not fit these categories, inventions which were as practical as the hydraulic draw-gate submitted by Nathan Sellers in 1811, as impractical as Henry's wind-carriage, or as conventional as the pile-driver of Ludwig Kuhn. With the establishment of the national patent system in 1790 this type of improvement found an outlet more appropriate than the museum of the American Philosophical Society, and the period of its involvement in the mechanic arts drew to a close.

### BALLOT BOX

Made by Benjamin Dearborn. Wooden box on legs, with a hinged aperture in the top, drawer in front, and carrying handle beneath. Contemporary (?) marking in ink, "Inventor. Presented

by Benjamin Dearborn, Feb. 5, 1808." Overall dimensions 10½" × 7" × 12".

The box has a wide slot in the back, below which it is divided into one open compartment and one closed compartment, the latter having a hole in the cover and housing a drawer opening from the front. The top of the box has the form of a shallow tray having a hinged trap-door at one end. This door is directly above the open compartment.

Benjamin Dearborn (1755–1838) was a resident of Boston, where, in 1790, he operated a school for girls. He was a prolific inventor of such variegated devices as a spring scale, grist mill, candlestick, and "facility for casting interest." He published a description of the latter device in 1805, and presented the invention to the Society. The ballot box is also described as an invention, as was the improved version presented to the Society in 1823 (58-16). Dearborn was elected a member of the Society in 1803.

(58-15)

**BALLOT BOX**

Made and presented by Benjamin Dearborn. Wooden box on legs, with a hinged aperture in the top, drawer in front, and carrying handle beneath. Unmarked. Overall dimensions, 11" × 7½" × 13½". Received in 1823.

This box is identical, except in dimensions, to the box presented by Dearborn in 1808 (58-15). It is described as an "improvement . . . calculated to conceal the manner of voting and to be used by the Society at their elections."

(58-16)

**BALLOT BOX**

Made and presented by T. U. Walter. Birdhouse-shaped wooden box with circular hole in front through which tallies are dropped to the right or left into separate drawers. The left hand side of the roof is marked "Reject," the right-hand, "Admit." Overall dimensions 10" × 10" × 10½". Received in 1840.

This is described in the Curator's Donation Book as an invention. The identity of Walter has not been determined.

(58-18)

**MODEL OF A "SPEEDY ELEVATOR"**

Made and presented by Nicholas Collin. Mahogany model consisting of an open frame 18" high, enclosing three other telescop-

ing frames of similar length, capable of extending to 73″. Each frame is slotted to fit those contained within it. A windlass at the base operates the elevator through simple pulleys. The base has folding projections to increase the effective base area. Unmarked. Received in 1796.

Collin describes this in the *Transactions*, o.s., 4: 519, 1799. He states that it combines ready approach to heights, not otherwise accessible without a great deal of trouble, with speedy ascent and descent. He mentions the use of it as a fire ladder, for the raising of a light, and for the elevation of a person for military reconnaissance.

Nicholas Collin (1746–1831) was born in Sweden, educated in theology at Upsala, and came to America as a missionary in 1770. He served as pastor in a number of churches in and around Philadelphia, becoming a member of the American Philosophical Society in 1789. Mechanics and invention were a hobby in which he gained a considerable reputation, and Secretary of State Jefferson employed him as an expert consultant in patent matters. He exhibited a model of a fire escape to the Society in 1791, and placed it in the museum, although it is no longer there. According to his biographer, Johnson, the elevator was brought forward in the same year, in a bid for the Magellanic Premium. It received that award—in 1804—and Collin was given a gold medal, now reportedly in the coin cabinet of the University of Upsala. The medal carries the date 1795.[20]

(58-19)

## MODEL OF A HYDRAULIC DRAW-GATE

Made and presented by Nathan Sellers. White pine model of a gate-frame, with a long wooden plug valve across the bottom. Overall dimensions 11½″ × 4″ × 4″. Marked with a contemporary (?) inked inscription, "Model of a Rolling-draw Gate presented by Nathan Sellers 19 April 1811."

A description received from Sellers in 1811 is printed, with a drawing, in a later volume of the *Transactions* (n.s., 1: 307–309, 1818). He developed the device in connection with the modification of the prime mover of his sawmill. He wanted to use a "common flutter wheel," which necessitated the placing of the gate at the bottom of a 14-foot head of water. The use of an iron plug valve with semicircular cross section was his solution. He indicates that he is offering the idea freely to those with a similar problem.

[20] Amandus Johnson, *Journal and biography of Nicholas Collin*, 116–117, Philadelphia, 1936.

Sellers was a Quaker trained in law, but possessed of an aptitude for mechanical invention which led him into a career in manufacturing. He had developed a process for drawing and annealing wire which served as a basis for the manufacture of sieves, paper molds, etc. During the Revolution he was withdrawn from the army to engage in essential manufacture of the latter.

(58-20)

**MODEL OF A PILE DRIVER**

Made and presented by Ludwig Kuhn. Wooden frame, 18¾″ high, on 8″ × 10″ base, with brass gearing, pulleys, and weight, the latter apparently filled with lead. Unmarked. Received in 1790.

The machine is to be operated by four men through a double-crank windlass. The weight is released automatically by a hook-releasing bar at the top. The windlass has the remains of what may have been a ratchet for the protection of the operators against the sudden release of tension. In an extant description Kuhn recommends the machine, which he calls a "ramming block," for erecting water-works in or about rivers, or swampy places. With it four men can easily raise a weight of 2,000 pounds ten feet in one second. He gives its dimensions, notably that of the great cog wheel, which must be 4 feet 3 inches in diameter. The machine when worked up "will discharge itself and immediately catch the tackling so that you can instantly proceed."

Kuhn, who is described as "lately from Manheim in Germany," also presented a model of a "convenient sick bed" at this time, but that model is no longer extant. He patented a bedstead (the same?) on August 10, 1791, but apparently not the pile driver.

The pile driver was known in antiquity and is mentioned by several medieval sources. It is also thought to have been known in primitive northern Europe. Jacopo Mariano (first half fifteenth century) mentioned a self-releasing pile driver, the type in question here. Kuhn's machine appears less sophisticated than some described a half-century earlier, e.g., by Desaguliers.

(58-21)

**MODEL OF A WIND-DRIVEN CARRIAGE** (Fig. 15)

Made and presented by William Henry. Wooden model of white pine and maple, except for sails and gearing. A flat triangular body rides on three wheels, the single rear wheel turning under the direction of a tiller. A system of gearing controls the single

fore-and-aft sail. Overall dimensions 14½″ × 14½″ × 19″ high. Unmarked. Received in 1785.

This device "to run against the wind by force of wind alone," resembles an ice boat, and does not appear to have been an invention of remarkable originality. Similar devices had been described much earlier, in Renaissance books on mechanics. They are mentioned frequently in seventeenth- and eighteenth-century works, and appear to have been actually used in the Low Countries and China.

William Henry (1729–1786) is one of the few early American mechanics whose ingenuity might be compared with that of David Rittenhouse. He was apprenticed to a gunsmith in Lancaster, Pennsylvania, about 1744, and this remained his principal trade. He was the chief supplier to the troops engaged in the Indian wars of 1755–1760. An inveterate inventor in the mechanical field, he is supposed to have operated a model steamboat on Conestoga Creek about 1763, and to have passed on some of his experience to Fitch, Rumsay, and Fulton, all of whom are said to have visited him. He was a member of the old American Society . . . for the Promotion and Propagation of Useful Knowledge, and submitted a model of at least one invention to that body. He joined the American Philosophical Society upon the amalgamation of that body and the American Society. Another of his inventions is described in Vol. I of the *Transactions*, o.s., 1: 286, 1771. Of these and other models which were probably submitted by him, the present specimen alone remains, so far as has been determined.

The model was reconstructed in 1959 from disassembled parts which existed in the collection. At that time a missing gear and idler connecting the two sail frames were fabricated.

(58-22)

**MODEL OF A BRIDGE** (Fig. 11)

Made and presented by John Jones, of Sussex County, Delaware. Wooden (oak) model of an arched bridge, the arch of which consists of six timbers bound together by iron straps and rods. Only half of the bridge is shown in detail. Length 68″, depth of arch, 14″. Unmarked. Received in 1786.

The second, and presumably symetrical, half of the arch is represented by two curved boards. The roadway is also shown only in outline. Only the upper and lower timbers extend the full length of the (half) arch. The remaining four are of various lengths, cut to fit the bottom timber to which they are fastened

by iron straps. Cross timbers held together by iron tie-rods hold together the top and bottom timbers.

The design of this bridge appears to be conventional. The wooden arch is ancient; perhaps the most well-known example was Trajan's bridge over the Danube near Warkel in Hungary, below the rapids of the "Iron Gate," which was built in A.D. 104. It is shown in relief on Trajan's column at Rome, and some remains of it have been found.

On the identity of the donor see the description of item 58-1.

(58-54)

# VIII

## *Agricultural Machinery*

In the eighteenth century no topic was given greater emphasis, among those who interested themselves in technological improvements, than agriculture. This was as true of the American Philosophical Society as of its European predecessors, but in 1785 a society for the promotion of agriculture was established in Philadelphia, with a cabinet of its own, and the period of the extensive involvement of the American Philosophical Society in agriculture proved to be short-lived.

**MODEL OF A MOWING MACHINE** (Fig. 16)

Made and presented by John Jones of Indian River. Wooden model of white pine and mahogany with steel cutter, 8″ × 2″ × 4½″. Unmarked. Received in 1771.

Its general appearance is that of the horse-drawn plow of the period. A large wheel which rolls along the ground has an integral pulley through which it drives a vertical shaft having a four-bladed cutter at its lower end.

A reaper with immovable cutters was used in Roman Gaul. Its modern history is supposed to have begun with Capel Lofft of England, who submitted a plan for a machine in 1785, in response to the offer of a premium by the Royal Society of Arts five years earlier. Its description has not survived. Mowing machines were patented from 1803, having as a very common feature circular cutters similar to those in the present specimen.[21] Jones' machine, "for working a number of scythes with a horse," as it is called in the Curator's Donation Book, appears to have been overlooked by historians of this subject, as it antedates by fourteen years even the shadowy machine of Lofft. It would seem that this specimen is the earliest design for a mowing machine of which we have record.

John Jones of Indian River is not to be confused with the more famous physician who was associated with King's College and the

[21] M. F. Miller, *The evolution of reaping mechines*, 12, Washington, 1902; P. W. Bidwell and J. I. Falconer, *History of agriculture in the northern United States, 1620 to 1860*, 212, Washington, 1925.

Pennsylvania Hospital. It has not been possible to determine his relationship to the John Jones of Maryland who was elected to membership in the American Philosophical Society in 1774, or to the John Jones of Sussex County, Delaware, who presented a model of a bridge (58-69) in 1786. It seems possible that these three are the same man. The mowing machine was presented through Owen Biddle, one of the Curators in 1770, and a member known to have been especially interested in improvements of this type.

(58-1)

**MODEL OF A CHEESE PRESS**

A simple wooden model of a press, 5″ × 2½″ × 7″, hand operated through a toggle. There is a ratchet on one side. Unmarked.

The history of this model appears to be entirely unrecorded, a circumstance which suggests that it may have been submitted for the Magellanic Premium, as these acquisitions were not recorded by the Curators. Its identification as a cheese press is conjectural but not improbable. A cheese press of similar form is shown in William Emerson, *Principles of Mechanics*, pl. 18, fig. 9, London, 1825. The ratchet, not part of Emerson's press, would appear to be for the purpose of securing a flexible band to give the cheese a circular form.

(58-44)

**MODEL OF A CHURN**

A glass jar with a wooden top, 8″ diameter, 12″ high. To the top is attached a geared stirring mechanism and crank through which two sets of paddles projecting within the jar can be caused to turn in opposite directions. Unmarked.

The history of this specimen is unrecorded. Its identification is based on the circumstance that it has the typical form of a churn. It must be admitted, however, that its construction is rather elegant for this mundane function.

(58-67)

# IX

## *Ship Models and Nautical Instruments*

In North America in the eighteenth century the improvement of transportation meant essentially the improvement of marine transportation, as the ship was as important at this time as the railroad and aircraft were to be in later eras. The oldest specimen in the collection, in point of acquisition, is a model of a pump designed to alleviate the burden of continuously pumping ships (58-11, fig. 17). An even more serious emergency was to be alleviated by the temporary rudder (58-53) of which a model, originally submitted to the Royal Society of Arts, is now in the American Philosophical Society collection. Because of its impassable forests, eastern North America was the scene of particularly feverish experimentation in the improvement of water transportation. The paddle boat of John Fitch (58-9, fig. 18) reminds us that this experimentation was not merely feverish, but that it also represented the effective beginning of the mechanically propelled boat.

**MODEL OF A PADDLE-DRIVEN BOAT** (Fig. 18)

Model made and presented by John Fitch. This is a hollow white pine model, 23″ × 6″ × 7″, apparently intended to exhibit only a paddle system. One side carries eight paddles on an endless chain. One of the two sprockets carrying this chain extends through the model to a wooden lever on the other side. Through this lever the movement of the paddle-chain can be demonstrated. Unmarked. Received in 1785.

Because of his spectacular rivalry with James Rumsey for the honor of having first put the steamboat into practice, Fitch's work has been a subject of great interest. He is supposed to have first arrived at the idea of a steamboat in April, 1785, and to have built one or more models that summer. The Minutes of the American Philosophical Society record, on September 27, 1785, that "The model with a drawing and description of a machine for working a boat against the stream by means of a steam engine was laid before the Society by Mr. John Fitch." There seems no

reason to doubt that this is the model, although the acquisition (like many others) escaped recording by the Curators, and it is not evident from the model that steam was involved. The description, no longer in the Society, was long thought to have been lost, but was recently reported located by Frank D. Prager in the Fitch Papers of the Library of Congress.[22] The engine there described and sketched may have been intended for this boat. It is essentially similar to that used in Fitch's first full-sized steamboat, which was demonstrated at Philadelphia in August, 1787, before the members of the Constitutional Convention.

(58-9)

**SHIP'S LOG**

Brass instrument 11¼″ high on 11½″ × 6″ mahogany base. Inscribed "Porter and Conner," and having affixed to it a contemporary (?) paper label marked "Porter's Constant Log."

The instrument consists of a vertical-turned brass rod having a slot in the top for a pulley or fulcrum which is missing. A pair of shorter rods support between them a pivoted brass quadrant, which is scaled but not numbered. The base is scaled radially from the axis of the quadrant.

This instrument is not mentioned in the records. It is surmised that it is the principal part of a ship's log in which the force of the float is counteracted by a weight attached to the quadrant.

It is further surmised that the names inscribed may refer to Commodore David Porter (1780–1843) and Commodore David Conner (1792–1856), both of whom had Philadelphia connections. Porter was born in Boston, but maintained a home in Chester, Pennsylvania, the home of his wife, from 1808. Connor was born in Harrisburg, Pennsylvania, but resided in Philadelphia when not on duty with the Navy, and was Commandant of the Philadelphia Navy Yard in 1849–1850. His wife was the daughter of Dr. Philip Syng Physick.

I have been unable to prove that Porter and Conner were acquainted, but it seems probable. Nor does the biography of the former by his son, D. D. Porter, furnish evidence for either this instrument or any particular interest in the subject. On the basis of the circumstantial evidence cited above, however, it is concluded that Porter is the most probable maker, and Conner the source, of this instrument.

(58-10)

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[22] See *Penna. Mag. Hist. and Biog.* **79:** 63ff., 1955.

## MODEL OF A MACHINE FOR PUMPING VESSELS AT SEA (Fig. 17)

Made by Richard Wells. 6″ high, on 7″ square base. Wood (white pine and oak) and wire construction. An axle on a wooden base carries a conventional piston pump at one end and, at the other, the remains of a rudimentary paddle-wheel (restored in 1958). Unmarked. Received in 1768.

The *Transactions* (o.s., 1: 289–292, 1771) contains a description and sketch of this machine. Wells declares that it is designed to rectify the problem of crew exhaustion through the necessity of continuously pumping leaks. A conventional suction pump is to be driven by a water-wheel rigged over the side of the ship, and powered by its motion. He takes pains to cite figures in answer to anticipated doubts as to its effectiveness.

This is the oldest item in the present collection, in terms of acquisition. It appears to have been originally presented to the American Society . . . for Promoting and Propagating Useful Knowledge, of which Wells was a member, and to have come to the American Philosophical Society on the amalgamation of the two groups.[23] Wells became a member of the American Philosophical Society in 1769.

(58-11)

## SEXTANT

Marked "Stancliffe, Maker, Philadelphia." 8″ radius. Brass construction. Scaled 0–155, in ½ degrees. There are two interchangeable telescopic sights, and the micrometer is read with a microscope. The instrument is boxed and has a leather carrying case. Received in 1850.

This is a high-quality sextant of the mid-nineteenth century. It appears to be identical to the typical sextant of such manuals as that of William Chauvanet,[24] and to instruments shown in the catalogues of British dealers at this time.

No Stancliffe is listed as an instrument-maker or dealer in the Philadelphia directory, but a Benjamin Stancliffe of Philadelphia is listed as a patentee of mechanical devices in 1820 and 1833. It is surmised that he is the maker of this instrument. It was presented by William Lowber.

(58-12)

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[23] Hindle, *op. cit.*, 133.

[24] *A manual of spherical and practical astronomy*, Philadelphia, 2nd ed., 1864.

## POCKET, OR BOX, SEXTANT

Brass circular box of 3″ diameter, 1¾″ high, into which is built a sextant. Unmarked. Received in 1950.

This type of instrument, designed for use in military reconnaisance and by explorers, appears in dealer's catalogues as early as the 1850's as an article of common use. The present instrument was reportedly used on the North Polar expeditions of Admiral Robert Peary. The donor received it from the arctic explorer, Albert Operti, and believes the latter to have obtained it from Dr. Edmund Otis Hovey, leader of the Crocker Land Expedition.

Presented by Robert Cushman Murphy.

(58-13)

## MODEL OF A LIFEBOAT

Made and presented by Talbot Hamilton. Short, solid white pine model of a boat, having two supporting legs at one end; 8″ × 4½″ × 2½″. The existence of only two legs and its abbreviated length suggest that the model may originally have been longer. The legs project through the hull and may have been meant to be retractable. The bottom has a longitudinal concave depression, and the deck a group of shallow slits and holes. One of the former is filled with cork and one of the latter is covered by a trap-door. Unmarked. Received in 1805.

The Curator's Donation Book states that the model, which it calls a "lifebuoy," was presented with a description, but this can no longer be found. The device may be one of a series designed to solve the problem of rescue from stranded ships in heavy surf. The most successful of these was the Francis life car of 1845.

Hamilton, who made and donated the model, was not a member of the American Philosophical Society, but appears in the records as the donor of other specimens, books, stones, etc., between 1804 and 1806. The Philadelphia directory of 1807 lists him as President of the "Scots Thistle Society," but does not list him elsewhere.

(58-14)

## MODEL OF A TEMPORARY SHIP'S RUDDER

Made by Captain Edward Pakenham. Wooden model of a rudder, 12¼″ long, with a maximum width of 1¾″. Unmarked. Received in 1847.

The model illustrates Pakenham's idea for the rigging of an

emergency rudder from materials presumably available on shipboard, such as planking, mast and jib stock. In 1789 he was awarded a gold medal for the device by the Royal Society of Arts, and the device is described in the *Transactions* of that body for that year (7: 205–218, pl. 4).

It would seem likely that the model was once in the collection of the Royal Society of Arts. According to the Curator's Donation Book of the American Philosophical Society it was sent to the father of the donor, George Ord, in 1795, by Capt. William J. Bell, American Consul in Hamburg.

(58-53)

**MODEL OF THE SLOOP-OF-WAR, PEACOCK**

52″ long. Received in 1959.

The *Peacock* was one of five vessels in the fleet commanded by Lieutenant Charles Wilkes on the United States Exploring Expedition, 1838–1842, and was the home of Philadelphia artist-naturalist, Titian Ramsay Peale, during that journey. This model, reputedly built by an unknown sailor on the Wilkes expedition, represents the *Peacock* as she was before her reconstruction for use on the expedition. She was built in New York in 1813 by Adam and Noah Brown, was reconstructed after 1826, according to plans of Samuel Humphries, Chief Constructor, U. S. Navy. Plans both before and after reconstruction exist in the National Archives.

Presented by Robert Cushman Murphy. Damaged gear and rigging restored.

(59-1)

# X

## *Timekeeping*

**ASTRONOMICAL CLOCK** (Figs. 19, 21)

Made by David Rittenhouse. Pine case without embellishment, 83½" high, 13¼" wide at waist. The dial is 10⅝" diameter, probably of cold silvered brass. Unmarked. Received about 1810.

Heavy brass plates with a pillar at each of the four corners contain the deadbeat escapement and going train of two many-toothed wheels. The motion work is between the dial and front plate. A small gear on the ⅌2 gear arbor drives a large gear carrying the minute hand. The hour hand is driven by the latter gear through a compound idler gear and pinion. The second hand is mounted on the escape wheel arbor. The pendulum vibrates seconds and is mercury compensated. It is in two pieces connected by a yoke, and suspended by two springs. A thermometer is mounted on the back of the case.

This clock was built by Rittenhouse for his observatory at Norriton, and used in the observations of the transit of Venus in 1769. It is described in Barton's Memoir of Rittenhouse (1817) as "an excellent timepiece, having for its pendulum rod a flat steel bar, with a bob weighing about 12 pounds, and vibrating in a small arc. This went eight days, did not stop when wound up, beat dead seconds, and was kept in motion by a weight of 5 pounds."[25]

In 1810 the executors of Rittenhouse's estate offered to transfer the clock and "instruments" (see 58-24, fig. 2) to the Society in return for the observatory building and site. This was accepted. The exact date of the transfer of the instruments is not known.

(58-23)

**TALL CASE CLOCK** (Figs. 20, 22)

Made by Edward Duffield. Mahogany case. Bell-top hood with three beet-shaped wooden finials, the base of the center one

[25] *Op. cit.* I am indebted to Mr. Edwin Battison for assistance in describing this specimen.

being flanked by brackets resembling thorny branches. 98″ high, 23¾″ wide at the hood. The dial is 12½″ square, of silvered brass. Marked, "Duffield, Philad[a]." Probably received in 1769.

The movement has a time train of four arbors and is conventional. The deadbeat escapement is located between the plates. An 8-pound pendulum with a pine rod and lens-shaped bob is driven by a crutch wire. It is adjustable but not compensated.

The Minutes of the American Philosophical Society for October 6, 1769, report:

> The committee appointed to agree with Mr. Duffield to make a time piece report that he has engaged to make one and has it in such forwardness that he expects to have it ready for observing the ensuing transit of Venus.

In the absence of other reference to the receipt of Duffield clocks by the Society (except for the grandmother clock, 58-63) it is concluded that this is the clock in question, and that it was used in the 1769 transit observations.

Edward Duffield (d. 1803) was active as a clockmaker in Philadelphia in the 1740's and 1750's, and in Lower Dublin for the following two decades. He was a close friend and executor of Franklin. He succeeded Thomas Stretch as custodian of the State House clock, built by the latter in 1762. Duffield was one of the early members of the Society.

(58-62)

## TALL CASE (GRANDMOTHER) CLOCK

Made by Edward Duffield. Mahogany case. Bell-top hood, having an arched window on each side. Brass dial with gilt corner spandrels. 82½″ high; width of hood, 16″. Marked, "Edw[d] Duffield, Philadelphia." There are two brass plaques on the door. The upper is inscribed, "Benjamin Franklin, Benjamin F. Bache, Hartman Bache;" the lower, "Richard Meade Bache, René Bache." Received in 1954.

There is a lunette occupied by a moon sphere half silvered and half black, with a short cylinder below bearing numbers of days of the moon's age, 5, 10, etc. The lunette spandrels each have a profile head wearing feathered headdress. The case and dial are highly decorated.

The movement has a time train of four arbors, recoil escapement, and is generally conventional. There is a day of the month circle, running in three grooved wheels behind the dial. A wooden pendulum rod (not original) is driven by a crutch wire.

The association of this clock with Franklin is not documented beyond the inference which can be drawn from the plates on the door. It should be noted, however, that Duffield was a close friend of Franklin, and reportedly made a watch for him.

Presented by Junius S. and Henry S. Morgan, sons of J. Pierpont Morgan, who purchased the clock from René Bache sometime before 1933.

(58-63)

## MODIFIED CLOCK

This is a common alarm clock which has been modified through the addition of three paper scales. The original face is marked "Jerome and Co." One of the paper scales is marked, "Pat. App. for." Dimensions, 6″ diameter × 4″.

A paper scale covering the original face is marked 0 to 60 and 1 to 12. A second perforated paper scale is attached to the minute hand, and is marked 1 to 15. A third is attached to the hour hand, and is marked radially over twelve radii. One set of these markings reads: Is. 15, A.I. 180, Oi 165, etc. A second set, upside down from the point of view of the first, reads: 15 R.S., 180 Gh, 165 C.B., etc.

No reference to this instrument has been found in the records. It may be designed to give simultaneous time at various localities.

(58-65)

## SUNDIAL

Made by John Iles of London. Octagonal plate of 9¼″ diameter, with 4″ gnomon, both of brass. Conventional style of garden dial. Marked, "John Iles, Londini, 1725, Sunny Hours." Received in 1956.

This dial, to be mounted on a pillar, is perhaps the most common type of sundial. It is inscribed with a figure of Father Time, the workmanship being rather crude.

This instrument has been traditionally associated with Benjamin Franklin, by the family of the donor. Franklin was reputedly interested in sundials, and has been alleged to have been responsible for the depiction of a dial and the motto, "Mind your business," on the colonial currency in the 1770's.[26] The motto on the present dial seems somewhat incongruous with this, but Franklin was a complex man.

Presented by Miss E. C. Chambers.

(58-64)

[26] Alice M. Earle, *Sun dials and roses of yesterday*, 22, New York, 1902.

**REFRACTIVE SUNDIAL** (Figs. 23, 24, 25)

Made by Christopher Schissler. Brass and alloy instrument, consisting of a bowl-shaped sundial, 12″ in diameter, supported on a 5¾″ base, both elaborately decorated. The connection between the two is not original. Prior to 1895 they existed as separate pieces in the collection. At that time they were assembled as at present and described by Julius F. Sachse.[27] The compass and part of the gnomon are missing. Engraved, "CHRISTOPHERUS SCHISSLER GEOMETRICUS AC ASTRONOMICUS ARTIFEX AUGUSTAE VINDELICORUM FACIEBAT ANNO 1578."

Ahaz, eleventh king of Judah, is held to have first described the sundial in the eighth century B.C. (although it appears that earlier dials existed in China). The term "Horologium Achaz" refers to the eighth verse of the thirty-eighth chapter of the Book of Isaiah, wherein is stated, "Behold, I will bring again the shadow of the degrees, which is gone down in the sundial of Ahaz ten degrees backward. So the sun returned ten degrees, by which degrees it was gone down." This and another miracle of Isaiah (twenty-first verse) are shown in scenes engraved on the base of the instrument. A Latin inscription in the center of the base explains that filling the bowl with water causes the shadow to move back ten degrees, thus repeating the miracle of Isaiah.[28]

In addition to serving as a refractive dial the instrument is marked for equal and planetary hours, common and Italian hours, with appropriate conversion tables. The base is elaborately engraved with a Biblical relief of the two miracles of Isaiah, and the bowl with the Zodiac. This type of dial requires both a vertical gnomon and a diagonal gnomon. In the present example the former consists of a pointed rod in the center of the bowl; the latter of a figure holding a staff (part of which is restored), mounted on the rim. A string from the center to the end of the staff forms the second gnomon. This appears to be the oldest extant refraction dial, and one of the only pieces by Schissler having astrological significance. It has been described as his most artistically and scientifically interesting piece.[29]

Sachse found reference to the instrument in the Memoirs of Zacharias von Uffenbach, who mentioned it in an account of the University of Helmstadt. In endeavoring to trace its subsequent history he suggests that it may have been among the instruments assembled by the Rosicrucian astronomer, Johann Jacob Zim-

[27] *Proc. Amer. Philos. Soc.* 34: 21–30, 1895.
[28] *Ibid.*, 22.
[29] M. Bobinger, *Christoph Schissler*, 113–119, Augsburg, 1954.

mermann, preparatory to his migration to Pennsylvania with others of the sect in 1691–1693. Zimmermann died on the eve of embarkation and his place as leader was taken by Johann Kelpius, who took charge of the community subsequently set up on the Wissahickon near Philadelphia. Upon Kelpius' death in 1708, the instruments passed to others, notably to Dr. Christopher Witt (d. 1765) who is known to have been friendly with Franklin and other members of the American Philosophical Society.

(58-66)

**CHINESE TABLET SUNDIAL**

Wooden instrument (boxwood?) consisting of two blocks hinged to fold open when in use. Dimensions 3¼″ × 2½″ × ½″, when closed. Marked with tables and scales in Chinese script.

A compass is set in the lower block. Both blocks are scaled to the gnomon which is a thread extending diagonally between them. The cover block has on its exterior surface a rotatable wooden disc with pointer and scale.

Dials of this type were common in Europe as well as in China over a long period. In the absence of other evidence, it is assumed that this dial was not an antique when received. The source is unknown.

(58-31)

# XI

## *Heating Appliances*

Yet another cardinal problem of eighteenth-century technology was that of domestic heating. As a subject of interest to Franklin, it is not surprising that proposals for the improvement of heating devices are frequently mentioned in the early records of the Society. In 1796 it offered a premium of sixty dollars for the improvement of stoves or fireplaces, particularly with a view to the "benefit of the poorer class of people," for whom earlier improvements in this field had proven too expensive. A surviving report of a committee on this contest, dated May 6, 1797, lists three applications, two of which still exist in the archives, along with another received after the close of the contest. The missing application was, unfortunately, that of the ultimate winner, who had identified himself as "Oeconomy." Neither he nor the other contestants identified themselves by name.[30]

Less diffident was another pair of stove-improvers, Charles Willson Peale and his son Raphaelle, who brought their ideas on heating before the Society at this time. But the Peales do not seem to have involved themselves in the stove contest, perhaps because they were not prepared to do so before the closing date. In any case their improvements were subsequently made the subject of a patent application, and on November 16, 1797, the Peales were granted what was the first United States patent on a fireplace. Like most of the other early patents, this one was subsequently lost in the Patent Office fire of 1836.

With the rise of the anthracite coal industry, Pennsylvanians had another and more peculiar problem in relation to heating, which was to become the subject of another contest. This was in the utilization of anthracite dust, which accumulated into veritable mountains as a by-product of the mining methods used for this rock-like fuel. In November, 1866, the Society offered an

[30] The announcement of the stove contest is printed in *Trans. Amer. Philos. Soc.* o.s., 4: v, 1799. The report of the committee is in the archives. The three surviving applications are in the Manuscript Communications on Trade, Navigation, Manufacturing, etc., Nos. 18, 20, and 22. I am indebted to Mr. S. Y. Edgerton for calling my attention to these entries and for advice in identifying these models.

award of five hundred dollars for the best invention for utilizing anthracite coal dust. During the subsequent fourteen years a total of thirteen applications for the award are mentioned in the *Transactions*, until, in 1880, the committee was discharged and the premium offer withdrawn. The Committee seems to have found only one application worthy of consideration, that of John E. Wootten, whose model of a locomotive boiler furnace is still in the collection (58-8).

The collection contains, in addition to the Wootten model, six quaint wood and paper models of stoves and fireplaces, all of which almost certainly represent the stove and furnace improvers of the end of the previous century. One (58-7) can be certainly identified as that submitted by the late entrant in the stove contest, as it carries a mark of identification. None of the others carry such marks. Two, however (58-2 and 58-3, fig. 26), correspond closely to the improvements mentioned by the Peales, and were probably submitted by them. Another pair (58-4 and 58-5, fig. 26) can with somewhat less assurance be attributed to "Oeconomy," the recipient of the stove contest premium. It is difficult to connect the remaining model with any of the contestants, although it is so similar in construction as to leave little doubt that it was made at this time.

**MODELS OF FIREPLACES** (Fig. 26)

Made by Charles Willson and Raphaelle Peale. The models are constructed of white pine and paper, in the following dimensions:

58-2 $3\frac{3}{4}'' \times 3\frac{1}{4}'' \times 9\frac{3}{4}''$
58-3 $3\frac{3}{4}'' \times 3\frac{1}{2}'' \times 5\frac{1}{2}''$

They are unmarked, but both mantels are decorated with ink sketches. They were received on March 17, 1797.

In a paper read to the Society on this date, and subsequently printed in Volume 5 of the old series of the *Transactions*, the Peales offer an invention designed to remedy the twin evils of the smoky fireplace and heat loss. Their novelty consisted of a chimney valve (damper) and a sliding mantel upon which the Peales say that they hold patent rights (as they did by the time of the publication of their paper in 1802). A description of one fireplace follows, and models are mentioned, without specification of the exact number.

The celebrated museum of Charles Willson Peale was established in Philadelphia in 1784, having arisen out of a collection of miniature portraits of his fellow officers made during the war.

It was located in the Philosophical Hall between 1794 and 1802, and Peale's experiments were designed, in part, to improve the heating of that edifice. Their improvements were the subject of the first United States patent on a fireplace, the specifications of which are unfortunately lost. A number were sold for ten dollars, installed.

Although unmarked, these two models embody the damper and sliding mantel cover mentioned in the *Transactions*, and are for this reason ascribed to the Peales.

(58-2; 58-3)

**MODELS OF STOVES** (Fig. 26)

Probably made by "Oeconomy," recipient, on March 15, 1799, of the premium offered by the Society for improvements in stoves and fireplaces. The models are constructed of white pine and paper, in the following dimensions:

58-4 $3\frac{3}{4}'' \times 3\frac{1}{2}'' \times 10''$
58-5 $3\frac{3}{4}'' \times 4\frac{1}{2}'' \times 9\frac{1}{2}''$

They are unmarked, and resemble models 58-2 and 58-3 in style of construction and finish, lacking the ink sketches which decorate the former. Whereas, however, the former are fireplaces, these two are tall stoves, set in corresponding chimney niches.

On May 6, 1797, a committee reported the examination of three applications received in response to the Society's offer of a sixty-dollar premium for the improvement of stoves or fireplaces, which offer had been made in the previous year. The award was finally made to one of these, whose application was signed with the pseudonym, "Oeconomy."

The Society's archives contain two of these three applications, the missing one, unfortunately, being Oeconomy's. But we do have a brief report on his application, from the committee mentioned above, a report which is singularly inconclusive, as it consists of observations of various improvements already known in Europe, leaving us to assume that these improvements were part of Oeconomy's application. Despite this judgment of the contestant who was to be adjudged the winner, the committee felt that, while "neither the principles nor the reasoning are new," Oeconomy and one of the other contestants had an "advantageous adaptation" which "well deserves the name of improvement." The third contestant, who proposed a projecting fireplace with a back removable by a chimney sweep, was not so highly judged.

The committee examined "various models" from Oeconomy.

They do not mention models from the other contestants, nor do the applications extant describe anything resembling models now in the collection. The committee's negative observations on Oeconomy's application—that the sacheverell,[31] damper, and the use of a stove in a fireplace niche were already known in Europe —can to some degree be correlated with the appearance of models 58-4 and 58-5. Both are tall stoves in niches; one has a damper. But one has a cover folding over the opening, not mentioned by the committee, and the somewhat mysterious sacheverell is not apparent on either. These apparent discrepancies may be a consequence of the equivocal character of the committee's remarks on Oeconomy's application.

(58-4; 58-5)

**MODEL OF A FIREPLACE** (Fig. 26)

Received from an unknown donor, probably about 1797. This is a complex model in which a fireplace is combined with a hearth. It has an oven above the fireplace and an incomplete tin stovepipe above the hearth. The construction is very similar to that of models 58-2 through 58-5.

The construction of this model resembles that of those of the Peales and Oeconomy, but nothing we know of their work refers to anything of this nature. In view of the variety of stove, fireplace, and chimney improvers associated with the Society in the 1790's, both within and outside of the stove contest, it is possible that this is the work of an unknown contributor whose activity is otherwise unrecorded.

(58-6)

**MODEL OF A STOVE**

Received on Nov. 3, 1797, from an unknown donor. A rectangular model of cardboard, 6″ × 8½″ × 10″, with a 7″ smoke pipe projecting above. It is marked in ink, "presented 3 November 1797," and with a monogram seal containing the letters "AC."

The Minutes report the receipt of this model on the above date, with a description which is still in the Society's archives. The presumption is made by the stove contest committee that the donor intended this for the premium offered, although the

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[31] A blowing device for stove chimneys was known as a "sacheverell," named, according to the *Oxford English Dictionary*, after Dr. Henry Sacheverell, "who made himself famous for blowing the coals of dissention" during the reign of Queen Anne!

contest had closed at the end of 1796. This application does not appear to have been considered for the award.

The model contains three separate chambers, arranged vertically, the upper one being an oven. The walls are double, including that of the smoke pipe. There are two wire pulls, apparently for dampers.

(58-7)

## MODEL OF A LOCOMOTIVE BOILER FURNACE

Finely made steel and cast iron model of a locomotive firebox supported by a frame to which is also attached a pair of locomotive wheels, eccentric, and actuating mechanism. Overall dimensions 19″ × 10½″ × 11″. Unmarked. Probably received in 1876.

The model features a subgrate assembly of vertical fingers which are actuated by the revolution of the wheels to rise periodically through the grate for the presumed purpose of breaking up clinkers. The only record of the specimen is a label found displayed with it (1958) identifying it as a "Locomotive boiler furnace; apparatus for burning anthracite coal."

In November, 1866, the Society offered an award of five hundred dollars for the best invention for utilizing anthracite coal dust. A letter of November 2, 1876 (F. Fraley to J. P. Lesley), announces the appointment of a committee to consider apparatus submitted by John E. Wootten of Reading, Pennsylvania. Wootten's apparatus is described as "a combination of apparatus by which ordinary anthracite coal waste from the dirt banks at the mines can be successfully and profitably burned in the furnaces of stationary and locomotive boilers" (*Proceedings* **16**: 214–217, 1876). A total of thirteen applications for the award are mentioned through Volume 18 of the *Proceedings*, without detail on the others. In that year (1880) the committee was discharged and the premium offer withdrawn.

Wootten was General Manager of the Philadelphia and Reading Railroad. He became interested in the problem of burning anthracite coal dust in 1876, and in the following year patented a locomotive boiler furnace for this purpose. The patented boiler, which subsequently found wide use, is not represented by the present specimen. It featured an unusually wide, shallow firebox rather than the grate cleaning assembly of the present model.[32]

Despite the lack of identity between the present specimen and Wootten's well-known patent, it is tentatively concluded that this is the model submitted by Wootten to the Society. No evi-

[32] See *Annual Report* of the Philadelphia and Reading Railroad for 1876.

dence has been found that any of the other contestants mentioned submitted models or were seriously considered.

(58-8)

## MODEL OF A BLAST FURNACE

A truncated pyramid of mahogany, 6″ long and 6″ high, consisting of interlocking halves. There is an oval aperture at the top, communicating with a cavity within. At the bottom holes in all four sides communicate with this cavity. Unmarked.

This specimen is not referred to in the Society's records. It may be a model submitted for the Magellanic Premium. Its identification as a furnace seems highly probable, because of the similarity of its form to that of the early nineteenth-century blast furnace: the external form of a truncated pyramid, the shape of the cavity within, and the location of the holes at the bottom. Two of these holes resemble closely the form of those through which the molten iron was taken, having what appears to be a sort of damstone and fauld. The other two are presumed to be for the entrance of the tuyeres.[33]

(58-17)

[33] See the furnace described in *The Emporium of Arts and Sciences*, n.s., 1: 115 ff., Philadelphia, 1813.

# XII

## *Apparatus for the Graphic Arts*

**POLYGRAPH** (Fig. 13)

Elegantly made brass-bound wooden box, 8½″ × 15″ × 3½″, with inlaid top. The top and bottom fold out to form a writing table. An integral frame supports two writing pens. A brass plate is inscribed "Hawkins' Patent Polygraph, Manufactured and Sold by I. H. Farthing, No. 43, Cornhill, London. No. 282." Received in 1850.

John Isaac Hawkins was an English mechanic residing in Philadelphia about 1800. He was a close friend of C. W. Peale, and an inventor of such various devices as a "Patent portable grand piano," a formula for waterproofing shoes, and an improvement in distillation. About 1802 he invented the polygraph, a paper-ruling machine, and the physiognotrace, the latter of which is probably the one invention attributed to a John J. (I.?) Hawkins in the U. S. patent records (pantograph and parallel ruler, May 17, 1803).

The polygraph was a device for writing more than one copy of a letter simultaneously, through pens connected by a mechanical linkage. As originally invented the device was apparently considered imperfect, as Hawkins left it, upon his departure for England in 1803, for Peale to perfect. Peale was to receive the American rights, save a ten per cent royalty. He did produce some for sale in October, 1803. The first one was reportedly sold to B. H. Latrobe, who showed it to Thomas Jefferson, subsequently its principal exponent. Despite Jefferson's enthusiasm the device does not appear to have been very widely adopted.[34]

Hawkins himself continued the improvement of the device, and manufactured it in England. The date of the present specimen is uncertain, as it has not been possible to trace the maker, Farthing. It was presented by a student of Jefferson, Nicholas P. Trist (1800–1874), a fact which lends credence to its alleged association with Jefferson.

(58-42)

[34] Sellers, Charles C., *Charles Willson Peale II. Later life*, Phila., *Mem. Amer. Philos. Soc.* 23(2): 157, 1947, is my principal source on Hawkins.

## CHINESE PRINTING BLOCK

4″ square wooden block, ⅗″ thick, with Chinese characters cut into one side, a typical type-block used in printing. Contemporary (?) paper label marked, "Specimen of Chinese block cutting from W. B. Diver (?), Macao July 1840." Received in 1841.

This block is a fragment, apparently one of several used to print a memorial written by some Chinese official around 1840 (possibly the Kwangtung Governor-General). It appears that this was one of the blocks used to print the bottom of the page, so that not only is the text to the right and left of it missing, but each line is only the bottom part of the total. The subject of the memorial appears to be a proposal for the use of some group (probably pirates) against the barbarians (probably the English). If successful, they are to be rewarded from the cargoes of the boats they capture.

Presented by Robley Dunglison (1798–1869), a British physician, medical writer, and teacher, who was brought to America by Jefferson as first Professor of Medicine at the University of Virginia (1825). He was elected a member of the American Philosophical Society in 1832, and, from 1836 to 1868, was a member of the faculty of the Jefferson Medical College, Philadelphia.

(58-43)

## LETTER PRESS

A professionally made press of wood construction, with worm and rack of gold-plated brass. The width of the jaw opening is 4⅝″. Faintly inked, "American Philosophical Society. Given by Francis Dacosta, May 21, 1819."

(58-45)

## COLLECTION OF BRASS STENCILS

Marked "Bery, Faiseur de Caractres . . ." Walnut box, 12½″ × 10″ × 3½″. It contains 413 brass stencils of different designs of characters of the alphabet, or fonts, several series of numerals, and a number of ornamental pieces. A secret drawer contains Benjamin Franklin's monogram, his carte de visite, and four wrought end and border pieces.

These examples of the best French typography during the last years of the monarchy reflect Franklin's revived interest in printing and typography during his Passy years. The Franklin collection of the American Philosophical Society includes an itemized bill for this, from Bery to Franklin, dated December

29, 1781, and a second bill for accessories, dated January 12, 1782. There are corresponding entries in the "Account book for family expenses." The stencils have been described by Dr. W. E. Lingelbach in the *Proc. Amer. Philos. Soc.* **92**(2): 79–100, 1948 (*Lib. Bull.* for 1948).

Obtained by purchase in 1947/48.

(58-48)

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FIG. 3. Achromatic telescope, marked "Dolland, London" (58-25, p. 11)

FIG. 4. Theodolite, Marked "Tho. Heath Londini Fecit." (58-30, p. 15)

Fig. 5. Dialytical telescope made by Ploessl, Vienna (58-26, p. 12)

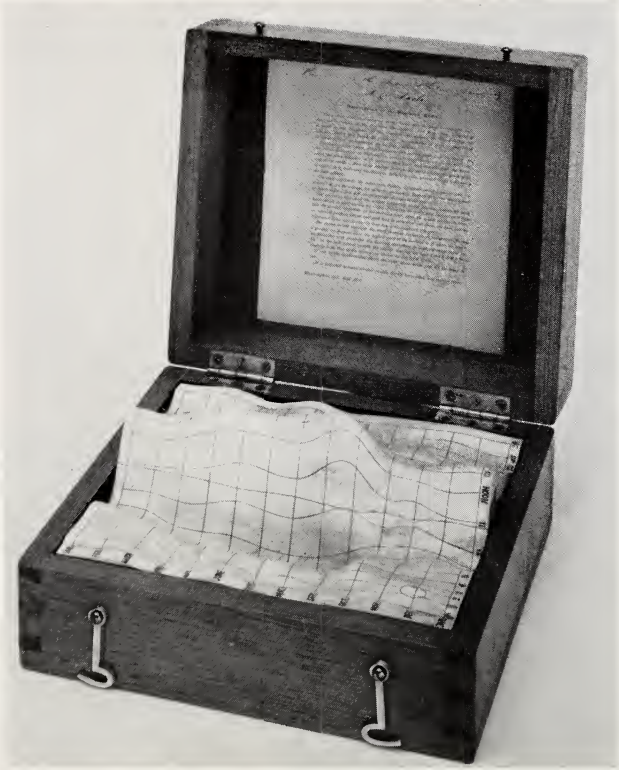

FIG. 6. Model to illustrate the diurnal variation of magnetic declination (58-29, p. 13)

FIG. 7. Instrument for measuring the horizontal intensity of the earth's magnetism (58-34, p. 14)

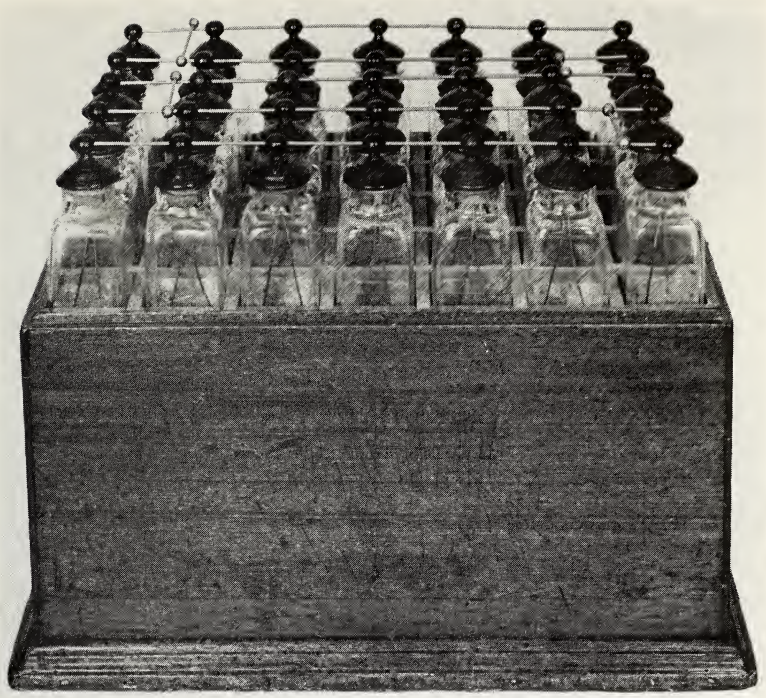

Fig. 8. Battery of Leyden jars used by Benjamin Franklin (58-36, p. 17)

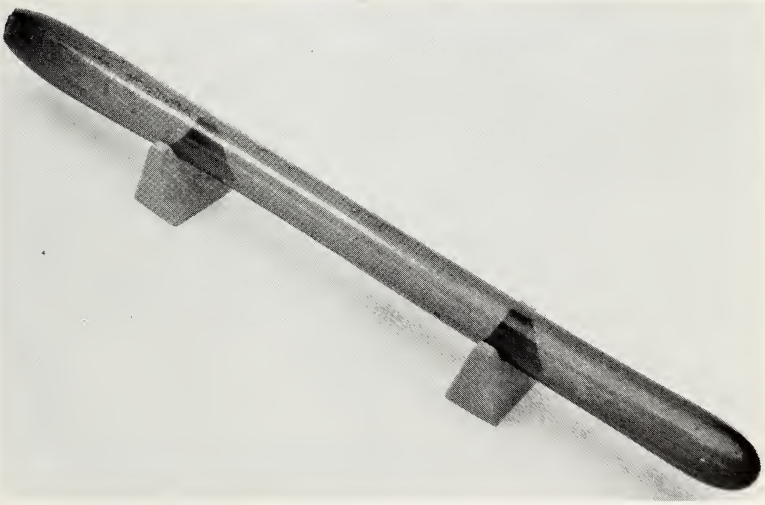

Fig. 9. Glass tube for the generation of static electricity (58-38, p. 19)

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FIG. 12. Apparatus for disinfection (58-59, p. 32)

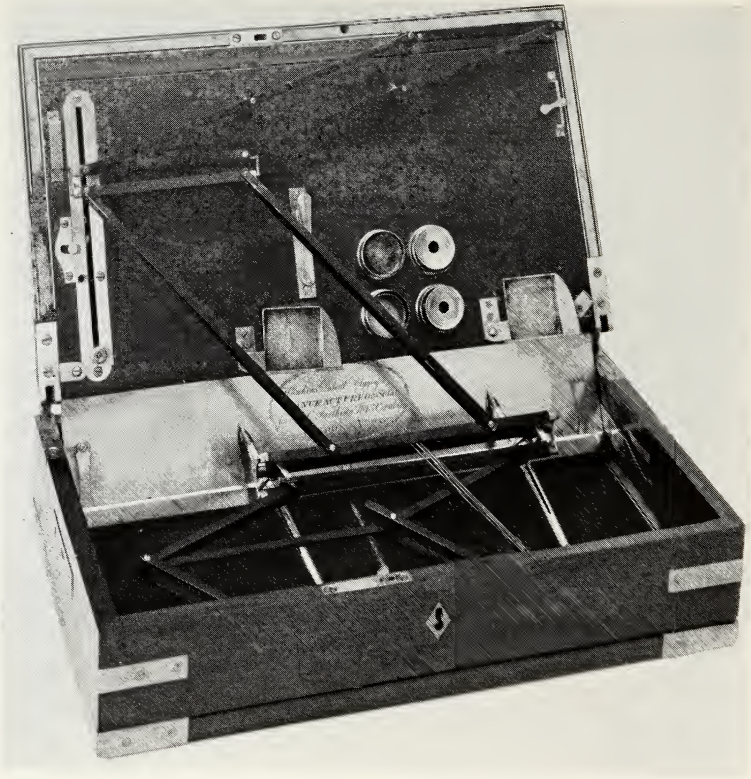

FIG. 13. Polygraph (58-42, p. 60)

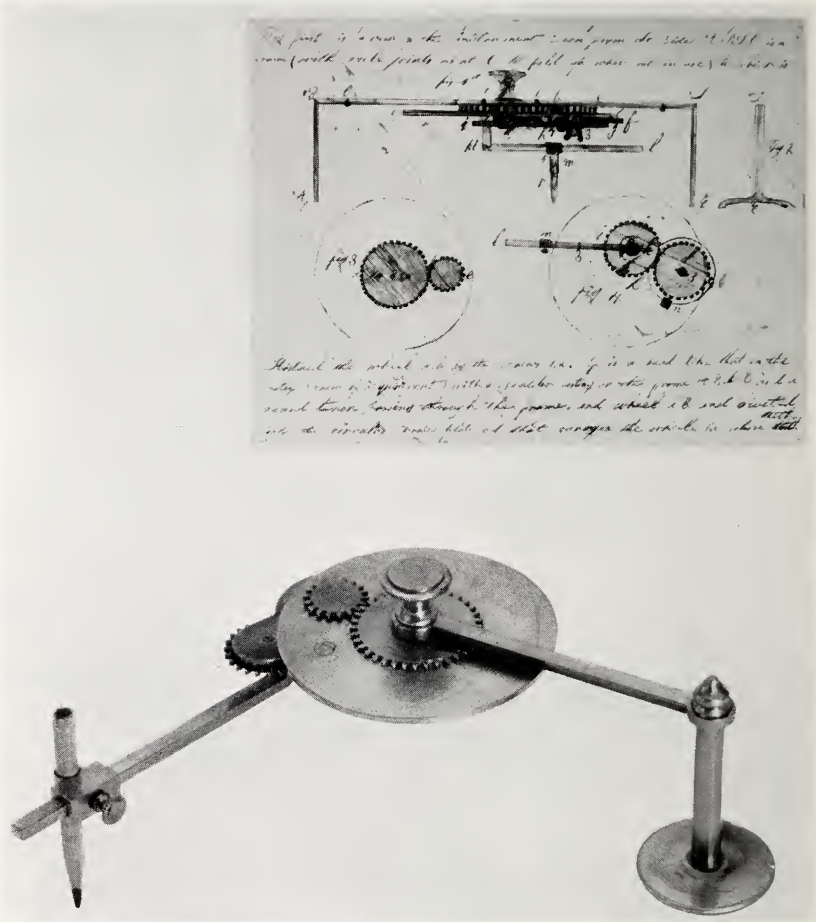

FIG. 14. Elliptograph and drawing of same in the Society's Archives (58-50, p. 34)

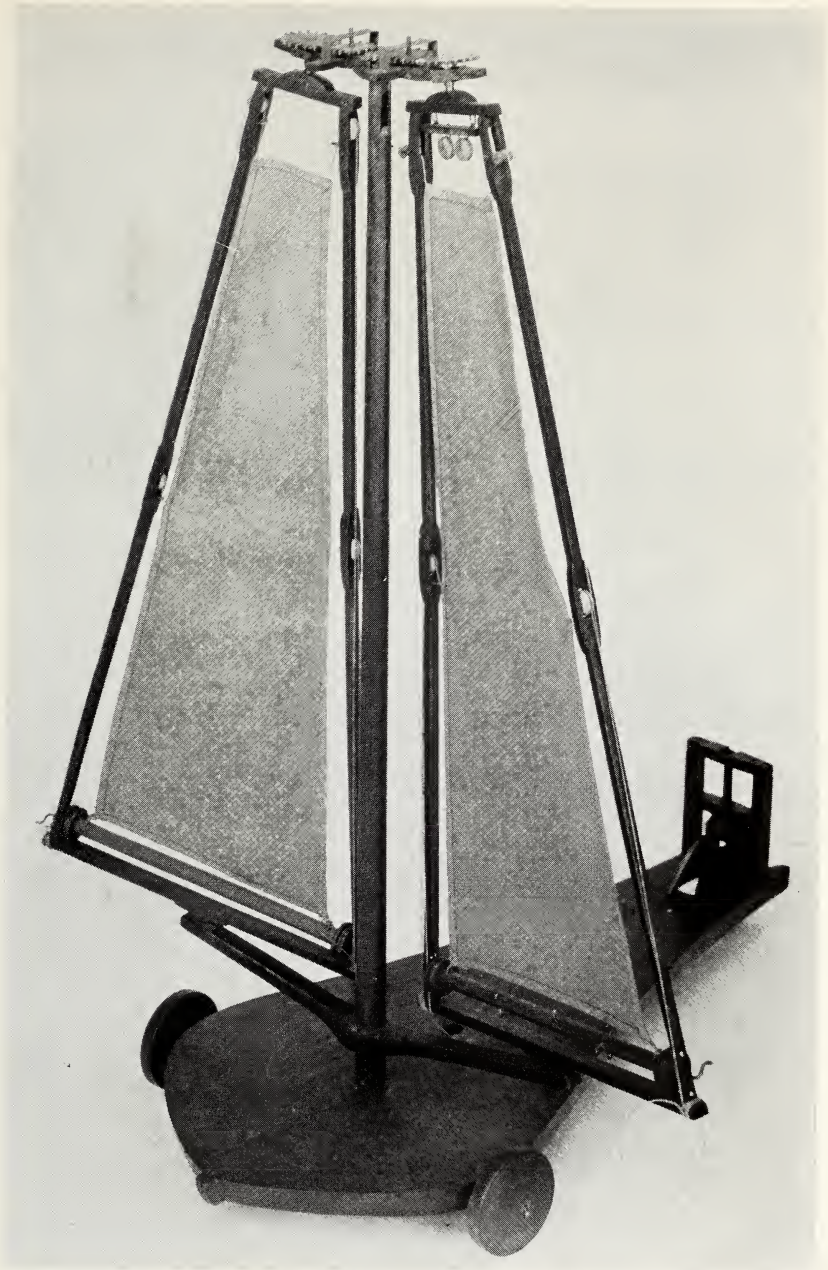

Fig. 15. Model of a wind-driven carriage made by William Henry (58-22, p. 39)

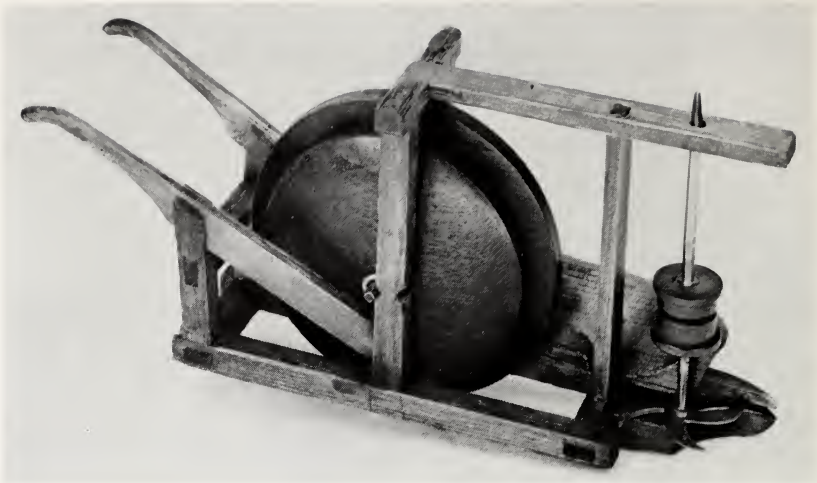

Fig. 16. Model of a mowing machine (58-1, p. 42)

Fig. 17. Model of a machine for pumping vessels at sea made by Richard Wells (58-11, p. 46)

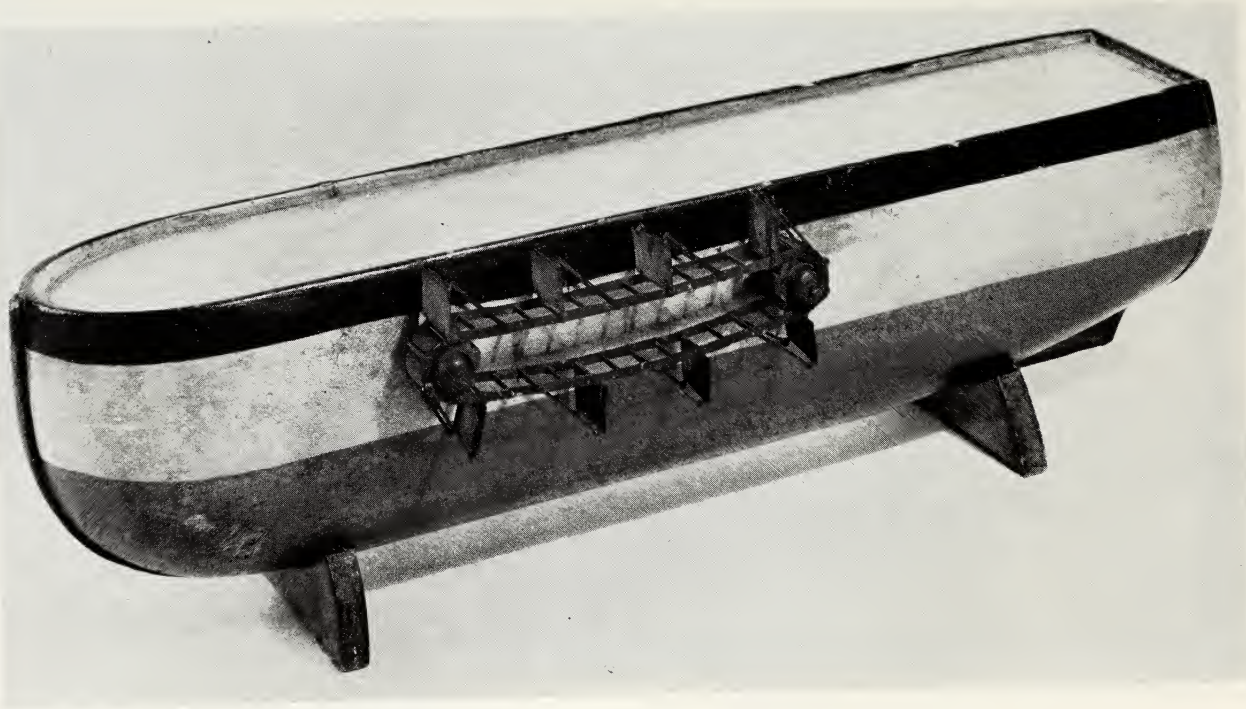

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FIG. 19. Astronomical clock, made by David Rittenhouse (58-23, p. 49)

FIG. 20. Tall case clock, made by Edward Duffield (58-62, p. 49)

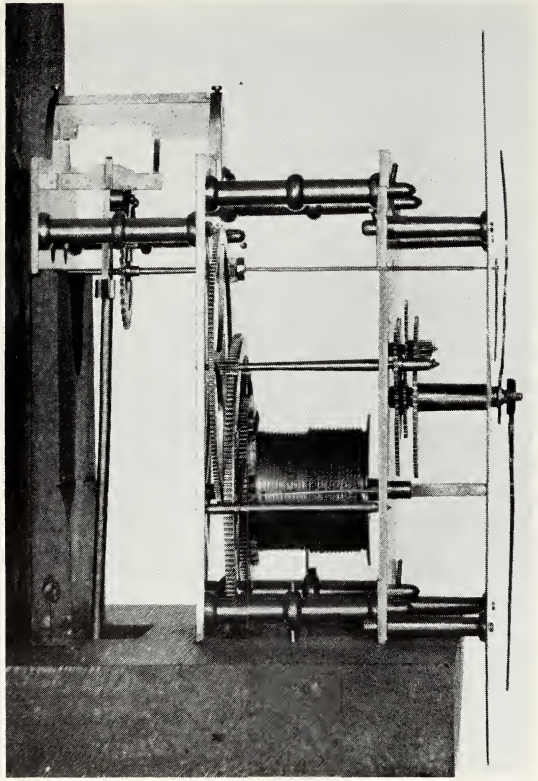

FIG. 21. Works of astronomical clock made by David Rittenhouse (58-23, p. 49)

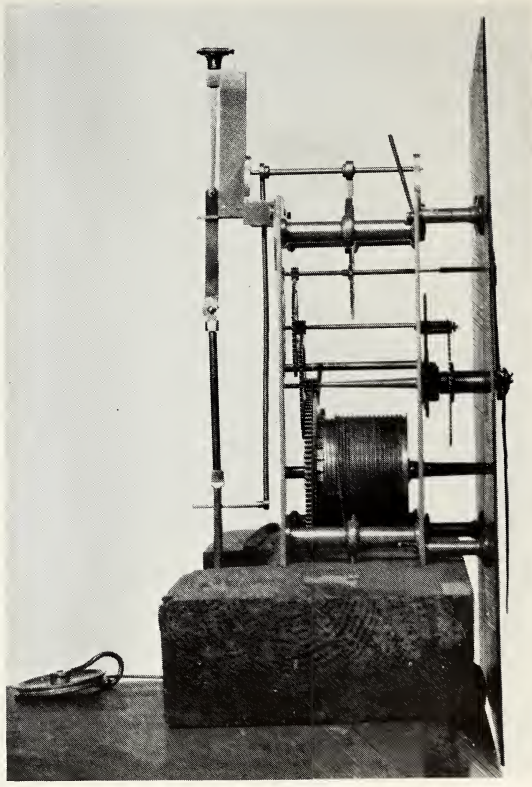

FIG. 22. Works of tall case clock made by Edward Duffield (58-62, p. 49)

Fig. 23. Refractive sundial made by Christopher Schissler (58-66, p. 52)

Fig. 24. Refractive sundial made by Christopher Schissler, bottom of bowl (58-66, p. 52)

Fig. 25. Refractive sundial made by Christopher Schissler, base. The tripod support is modern. (58-66, p. 52)

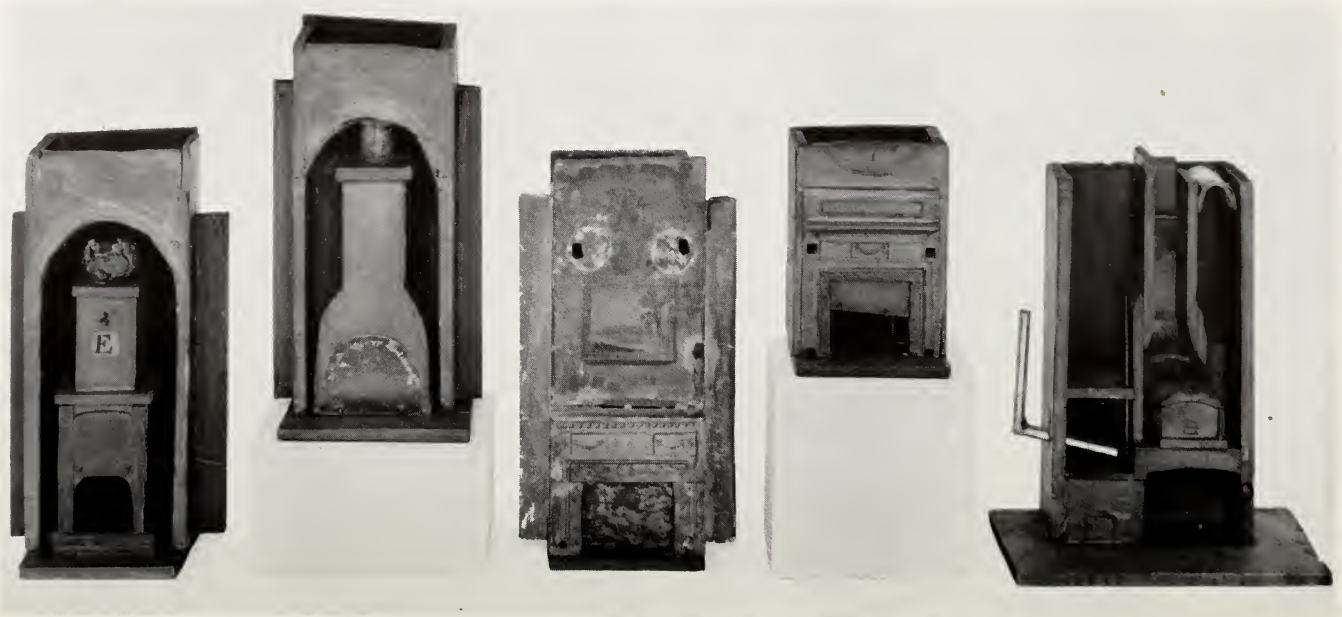


Fig. 26. Models of fireplaces and stoves (left to right, 58-4, 58-5, p. 56; 58-2, 58-3, p. 55; 58-6, p. 57)

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